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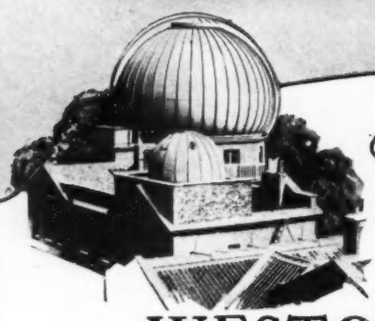

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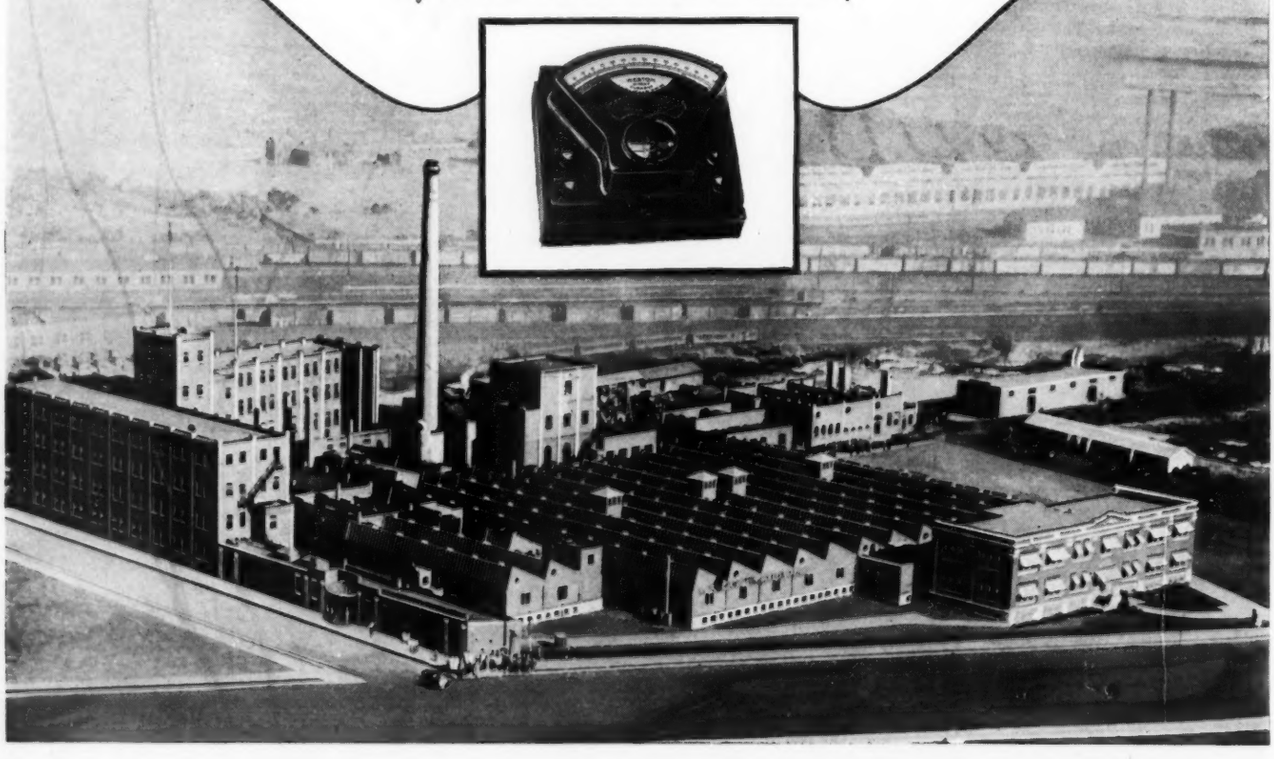

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Bonbright Survey

Now Available

THE name of every electric power company serving a town or city of 2,500 population or larger is indicated in a series of state maps in the new edition of the Bonbright Survey of the Electric Light and Power Industry, just off the press. The maps are so keyed that the location of properties under the same management, or of communities served from a common source, is revealed at a glance. In addition, the publication gives financial statistics for every important operating company and shows corporate relationships revised to October, 1927.

Compared with the preceding edition, more than 2,000 alterations in maps, tables and statements of corporate set-ups were necessary to take account of changes that have occurred since publication of the third edition in the summer of 1926. These changes are entirely aside from the complete revision of financial data covering all operations of sufficient magnitude to warrant inclusion.

The present edition of the Survey, like the last, was prepared with the co-operation of the electric companies themselves and of Bonbright & Company by members of the statistical staff of the ELECTRICAL WORLD, who devoted about five months to the gathering of material, correspondence for clearing up doubtful points, compilation of the returns, preparation of maps, incorporation of late changes discovered by critical comparison with records on file in the office of the ELECTRICAL WORLD, and final verification of proofs by reporting companies.

Watch for the

Statistical Issue

of ELECTRICAL WORLD, Jan. 7, 1928

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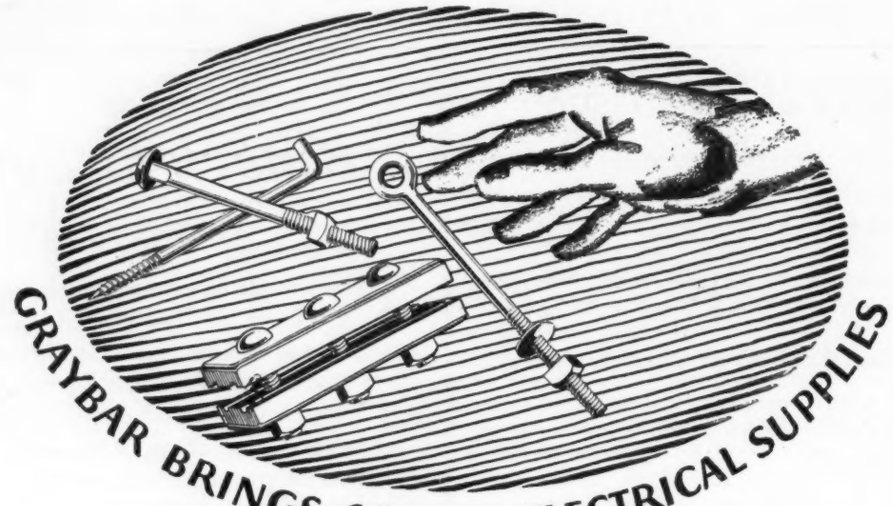

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Electrical World

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W. H. ONKEN, JR.
Editor

VOLUME 90 — *New York, Saturday, December 17, 1927* — NUMBER 25

Watchful Waiting

ALTHOUGH the President in his message to Congress suggested that Muscle Shoals be disposed of and the revenue derived therefrom be applied to research for methods of more economical production of fertilizer, and that so far as the Colorado River is concerned "every other possibility should be exhausted before the federal government should become engaged in the power business," it is problematical whether the Seventieth Congress will reach any conclusion on either matter. However, time confirms decisions founded on realities, and while the electric light and power industry cannot tarry until Congress makes up its mind, eventually the truth will prevail and Muscle Shoals will be linked with the Southeastern power network and the Colorado River will no longer plague Imperial Valley, or the city of Los Angeles, or even the power companies of California.

This does not mean that these two legislative measures may be ignored. On the contrary, it will be necessary to keep the facts constantly before Congress and to watch the machinations of the proponents of the two bills, for they are very adroit. Time and facts are both on the side of the electric light and power industry, however, and while delay is irksome and costly, it has its compensations. Justice moves with leaden feet, but it prevails none the less.

* * * *

Making Progress by Taking Counsel

REGIONAL meetings of commercial, industrial and agricultural interests shared by public utilities present many opportunities for progress through co-operation on behalf of the general welfare. At the third New England conference, held recently at Springfield, the fruits of two years' work toward increased unity of purpose among the six northeastern states were very much apparent. Public utilities and electrical manufacturers have played responsible parts in developing interstate team play and a better understanding of their own aims by citizens generally. The flood in Vermont and northern New Hampshire and the participation of Secretary Hoover in a special session of the conference resulting from the disaster brought all New Englanders closer together and opened the way for further co-operation by utilities and private interests on behalf of constructive development.

From the standpoint of the electrical industry, interconnection was the keynote of the first conference, held at Worcester two years ago. Last year at Hartford interstate transmission and rural electrification were prominent in the sessions, and this year flood control was a dominant topic. None of these problems has been completely solved, but real progress is being made in them all. Popular appreciation of the value of interconnection has greatly increased; unthinking hostility to the power companies on account of the economic limitations of rural-line extension practice is much lessened; important data bearing upon the value of storage reservoirs in flood control have been broadcast, and further construction has been promised. The representatives of the New England governors and of the utilities are studying a memorandum draft setting forth the basis upon which the investment of capital in interstate transmission will be mutually acceptable, and the long-suffering power export situation in Maine shows signs of more healthy activity. The New England electrical industry is working shoulder to shoulder with all builders of good will and material prosperity.

* * * *

Thermal Versus Dollar Generation

ENGINEERS have made large gains in changing fuel energy into electrical energy and have many more possibilities for increased thermal economy. Visualization of the use of two fluid cycles, higher pressures and temperatures, a greater degree of recirculation and many refinements in equipment design points to gains in efficiency as great as have been made in the last six years. The determining factor is the total cost of energy at the switchboard and the reliability of the energy. When dollars are weighed in efficiency scales they dominate the situation.

Radical departures in station designs have occurred in the recent past. In general, these stations have come up to their designers' predictions and in nearly all cases have decreased the total cost of energy. As a result of these experiences stations can now be designed at a very low total cost which will generate energy at about 27 per cent thermal efficiency. New stations will be built with these facts in mind. But several schools of opinion exist as to certain features of design. Shall one steam generating unit per turbo-generator be used? Shall high-heat transfer rates per square foot of furnace area be used in order to decrease the size of steam generating units? Can all metal furnaces be used at low and high ratings? Are stokers unsuitable for large units operating at high ratings? Shall reheating be used? If so, what kind and type?

At the meeting of the American Society of Mechanical Engineers last week it was made very evident that different answers are given to these questions by different engineers. In many cases enthusiastic advocates made statements which could not be supported by data, and in other cases experiences only with local fuel or plants were used to draw generalized conclusions. In still other cases everybody had opinions but nobody had facts.

Caution should be used in departing very far from existing designs in the next group of large power stations to be built. Coal is plentiful and comparatively cheap, and the cost of fuel is only 20 to 30 per cent of the total energy cost in the large modern station. Fixed charges

are relatively high and should dominate the trend in design, and above all else in large station layouts reliability of service should be considered. Under conditions that face the industry it is the part of wisdom to be conservative in new station designs. This does not mean that developments should stop. They are essential and should be supported, but this support need not involve gambling millions of dollars on a large power station of untried design.

* * * *

Electrifying the "Narrow-Gage"

ANOTHER desirable step in railroad electrification is forecast in the announcement of the Boston, Revere Beach & Lynn line that steam traction will be replaced by electric motive power as soon as possible after the plans of the new management are approved by the public authorities. This well-known narrow-gage interurban road handles a heavy commuting traffic the year through besides an enormous volume of seasonal business in summer. It is well adapted to profit by electrification, which ought to speed up the present rather slow service rendered by steam locomotives with their decided limitations as to acceleration, cleanliness and flexibility. Here appears to be a substantial block of new power business for the central stations of the region, and it is significant that no apparent intention exists to do otherwise than to contract for the energy needed to put new life into the stations, yards and rolling stock of this long useful property. Coming so soon after the intimation of the Massachusetts Department of Public Utilities that the Boston Elevated Railway might well save many hundreds of thousands of dollars yearly by buying central-station power, the announcement of the "Narrow-Gage" road, as it has been known for generations in New England, evidences a progressive spirit in management bound to enhance the public welfare all along the Boston north shore.

* * * *

Some Plain Talk on the Cost of Wiring

DIFFERENCES of opinion are natural enough in the discussion of anything as abstract as the cost of wiring. Power-company men quite generally believe that house wiring costs too much. Contractors, manufacturers of wiring materials and men who are concerned with the operation of the National Electrical Code believe that the cost of labor and material cannot be reduced with present standards and methods. Everybody believes that adequate safety standards must be maintained, but everybody will, of course, agree that it would be splendid if somebody could develop new materials that would make possible simpler installation methods and reduce the cost of the wiring job, so that the householder could buy more outlets for the same money. Therefore it is perfectly all right for the Edison sales managers or anybody else to go adventuring in wiring methods and to carry their experiments as far as they can, in hope of discovering something that will be helpful.

Meanwhile, however, one point should not be forgotten. The development of the National Electrical Code itself has been one long process of just this kind of search and experiment. Competition between manufacturers is continually spurring them to devise new materials and methods that will be cheaper and bring them an advantage in the market. The growth of the code has seen a reaction from commercial and economic pressure and the rising trend of standards of both safety and workmanship. It is a slow process. It must be. Therefore the development and discovery of these cheaper materials and methods that the power men are clamoring for and the entire industry would naturally welcome will take time. Before such new materials are designed, perfected, produced, tested, accepted by the industry and introduced into use, with resulting changes in installation methods that save labor, not months but several years will probably elapse.

So critics of present wiring costs must ask themselves some questions and face the issue. Since there is little likelihood that present materials will ever be purchased much more cheaply than now, and since there is no reason to expect that labor will soon accept lower wages, what should the industry do? Shall it wait around and rub a tin lamp until cheap wiring comes? Or shall it tighten its belt and go to work to sell adequate house wiring right now at present costs? There can be only one answer.

House wiring—and rewiring—can be sold at present costs. True, it never has been done adequately, but that proves nothing. The issue is clear-cut: Shall the industry sell what it has and develop this great residence market? Or is it afraid to tackle the job because the task looks hard?

* * * *

Education Depends on Teachers

A VERY thorough investigation of engineering education has been made during the past two or three years. This has been done by the engineering educators themselves under the able leadership of W. E. Wickenden. Published details of the results show that very encouraging progress has been made in course content, teaching methods and balance of emphasis. Engineering educators have built this big business, which deals with human raw materials, with very little aid from outsiders. The results speak well for the business sense of a group which is too frequently alleged to have no business sense. Despite criticism, lack of support and absence of constructive suggestions, these educators have built a going concern which is a credit to the country and to themselves.

But there runs through the whole mesh of engineering education an opportunity for outsiders to help. As never before, it is essential that a business program be developed whereby the users of the products from the mills of education shall co-operate with educators directly and effectively. This program should deal primarily with the problem of teaching personnel. The ablest teachers possible to find should be in our engineering schools, and in measurements for ability personality should be placed on an equality with knowledge. The type of engineer that makes the best teacher is the type that industry is demanding for executive positions, and the schools cannot compete. As a result there is evidence of a decrease in the supply of good teachers. There are many vacancies in the higher positions because the available teaching personnel is below standard and because the money is not available to attract men from industry—the wealthy retired engineer is not the type demanded for heads of engineering departments. Even in the subordinate teaching positions, good men cannot be had, because

industry sifts graduating classes for men with the executive type of personality and absorbs them. In addition to the low supply of good teachers is the fact that contacts between industry and educators are getting badly strained. Teachers who are alert and ambitious cannot afford to keep in touch with industry or are devoting most of their energies to consulting engineering, and the "deadwood" type of teacher has no ambition to find out what the professional men are thinking and doing.

Increased endowments for engineering schools are not the answer to the problem of teaching personnel—far better approaches can be made. For example, each professional engineering society could put its educational committee to work. Teachers could be farmed out to industry for stated periods, and young industrial leaders could be farmed out to schools. A plan of this kind would be especially potent for training the younger teachers. The older men should have the opportunity to attend meetings and conventions and to work on engineering committees without fear of financial losses. Many other helpful co-operative plans will suggest themselves.

If industry and the professional societies do not grasp the situation, conditions will grow worse, education will suffer, and perhaps government will be forced to take a hand in technical training. So worthy a cause and so vital a problem will surely receive the devoted attention of industry leaders.

* * * *

Relighting Possibilities in Old Homes

REFIXTURING activity is in full swing in some communities and the reports are interesting even though conflicting. At least, it is indicated that the electrical interests have much to learn and that some of them are learning. It is inevitable that they must find out how to do this work, which has never yet been done successfully in the residential field. Amid the discouragements which are bound to arise it should be borne in mind that a great opportunity exists for bringing good lighting into millions of homes. Besides this, there are indications that the householder is awakening, at least slightly, to the importance and possibilities of modern artificial light in the domestic sphere.

The opportunity which exists may be appreciated by considering the equipment and connected load in a remodeled house of seven rooms which has been wired and lighted according to modern lighting plans based upon utilitarian needs. The old wiring consisted of eight outlets in which the connected load was 350 watts from ten tungsten-filament lamps. The new wiring consists of 75 outlets for lighting equipment and appliances. Now there are 70 sockets containing as many tungsten-filament lamps and the total connected lighting load is 3,670 watts. This is an increase of more than 1,000 per cent. Furthermore, it may be emphasized that all of this lighting equipment is justified from the viewpoint of convenient and adequate utilitarian lighting. In other words, none of it is purely decorative. It is also interesting to compare this lighting load with that in the average home in this country, which, incidentally, contains between six and seven rooms. In the average home at the present time there are 27 sockets containing tungsten-filament lamps aggregating about 950 watts. Thus in the remodeled house the connected load is nearly four times that in the average home.

The Broader Interest in This Buyers' Market

IN HIS recent speech to the Electric Association in Chicago, Samuel Insull sounded what might well be taken for a keynote. It came as a closing thought in his address, but it deserves the very serious consideration of the electrical industry. He said:

> If competition in the sale of turbo-generators or cables or transformers is so keen as to hamper research work and threaten the quality or the rate of development; if too narrow margins restrict the wholesalers' ability to carry adequate stocks, supply sales service and extend credit to the retailer; if the keenness of competition between contractors impairs the adequacy or quality of wiring; if construction is hampered or not properly remunerated on account of policies in the other branches of the business—if any of these things happen, the central-station companies which use those materials and services finally suffer the most.

In other words—still quoting—the paramount responsibility imposed on all members of the industry by their common interest is to see to it that no obstacles are placed in the way of general electrical development. That is the thought. But, though Mr. Insull was speaking in general terms, it is a thought that calls for study, not in the general but in the particular. Are there apparent, for example, any instances where one branch of the industry is right now working injury upon another?

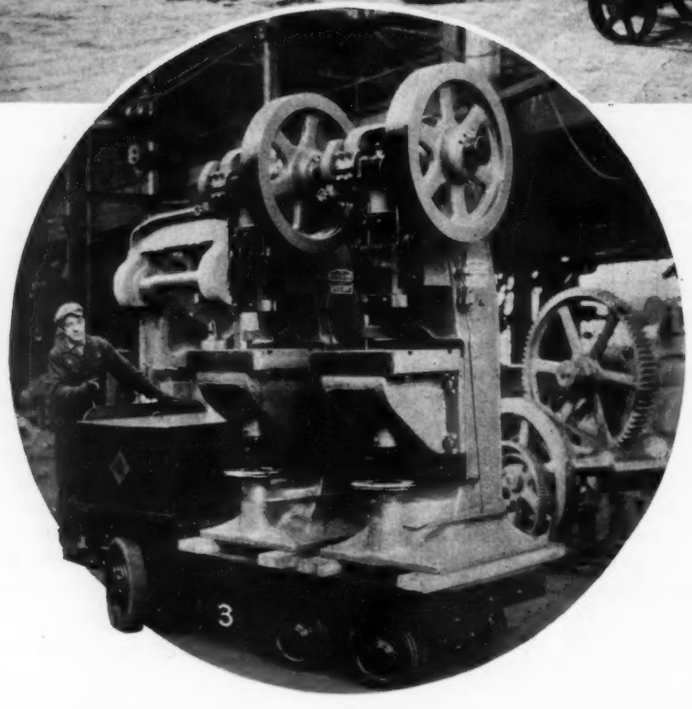
One case is very definitely before the industry. We are in a buyers' market; in a great many lines of electrical manufacture there is overproduction and idle plant capacity, and the purchasing agent is in the saddle, riding high with whip and spur. The question raised here in applying Mr. Insull's broad comment is simply this, how far can the seller be squeezed before the situation begins to run counter to the basic interests of the industry and the public? Some of the large buyers of electrical apparatus should take this under careful consideration.

It is perfectly natural for the buyer to take advantage of competition among manufacturers and seek the lowest bid. No one quarrels with his right to good prices. The danger comes when systematic pressure is so ingeniously applied that price standards are beaten down below the profit point. Then it is that quality of product and progress of development are threatened and the industry begins to destroy one of its own most priceless resources—its ability to produce and to advance. This common asset every electrical man should be ready to safeguard, no matter on which side of the market he may be at the moment. At the same time, with equal responsibility, the manufacturer himself must manfully protect these resources by courage in maintaining his listed prices, for the seller who weakly cuts prices as a bait for orders is no less culpable in this destructive process.

No one branch of the electrical industry can afford to think for itself alone. It must be alert to sense that point where insistence on its own advantage reacts through the impairment of the general economic health. And this consideration should be carefully applied wherever the class purposes of any of the several groups of electrical men seem to clash, whether it be the manufacturer, jobber, contractor-dealer or power company that is involved. The coming era of more intensive marketing will need more of this spirit between electrical men.

Burden Bearers of Industry

TO COMPUTE the total savings of the industrial electric truck during the past decade in modern manufacturing would be a next to impossible task, but there is no doubt that in a vast number of installations these equipments have paid for themselves within the first year or two of service. The trend toward requiring industrial trucks to perform increasingly heavy duties is yearly evident, and the accompanying views illustrate some difficult tasks which are being performed with these electrically operated units.



No. 1. Turning a hard corner in unloading tin plate from a freight car at the American Can Company's Seattle plant.

No. 2. Old versus new method of handling pig lead. Time of three men was saved by the electric truck at the left.

No. 3. Speeding up the millwright's work by transferring an 1,800-lb. press by boom attached to lift truck in a Philadelphia factory.

Choosing Power Equipment*

Method of evaluating bids based on curves plotted from operating conditions and guaranteed performance. Examples of application to specific cases

By J. N. LANDIS
Plant Equipment Engineer Brooklyn Edison Company

WITH the great variety of kinds and sizes of equipment that can be purchased, it becomes essential, in anything but arbitrary engineering and purchasing, to develop an analytical engineering and economic basis for settlement of questions relating to type, size and make of equipment. Organization of the material involves (1) a general review of a simple evaluation scheme, (2) application of the evaluation scheme to a specific problem and (3) discussion of certain detailed considerations of the problem.

For a simple specific illustration, the evaluation of annual operating cost and carrying charge for a particular turbine and steam-generating equipment for which guarantees will be assumed to be in hand is chosen. The most obvious starting point is with the daily load curves when these are available for some known year of the unit's operation. Such a curve is shown in Fig. 1. If this curve is redrawn without reference to the time sequence of machine loading, a load-duration curve (Fig. 4) will result. If 365 successive daily-load duration curves, or a smaller number of properly weighted typical daily-load duration curves, are added together, an annual load duration curve is obtained (Fig. 16).

The turbine proposal will contain a turbine heat-rate curve (Fig. 9) showing the amount of heat consumed by the turbine per kilowatt-hour for each load. The steam-generator proposal will contain an efficiency curve (Fig. 19), showing the ratio of output to input for the fuel-burning equipment, boiler and economizer or air preheater. If the ordinates of the turbine heat-rate curve (Fig. 9) are multiplied by the respective abscissas, there result values from which a turbine input-output curve can be plotted (Fig. 7). If for particular values of heat required by the turbine to produce certain loads the corresponding boiler efficiency is obtained and divided into the turbine heat requirement, then the result represents the boiler input necessary to generate the heat required by the turbine for the assumed turbine load. If the entire turbine load range is so treated, it is possible from the results to plot a boiler-input vs. turbine-output relationship (Fig. 7).

Based on address before Metropolitan Section A.S.M.E. entitled "Engineering Analysis as Applied to the Selection of Type and Size of Power Plant Equipment."

A Method of Attack to Follow in Engineering Analyses

[1]

For the equipment under consideration establish a machine load duration curve.

[2]

Determine a "use expectancy factor."

[3]

Determine the expected performance of each of a number of favorable appearing plans, taking due account of all the factors affecting the problem in any important way.

[4]

Combine the load duration data and the performance data to secure an expression of hourly performance cost against hours of duration of such costs. This information will enable determining by integration the total effective annual coal cost.

[5]

Determine costs of the different schemes completely installed and, if possible, approximate maintenance costs; also any other credits or charges of sufficient importance to merit a money evaluation.

[6]

Add together the total effective average annual operating cost, the annual carrying charge on investment, and other evaluations. These totals, one for each scheme investigated, represent the annual total costs. These totals will afford an idea of the monetary significance of each plan as compared with the others.

How Coal Consumption Is Figured from Foregoing

If reference is made to the load-duration curve with the input-output relationship in mind, it will be seen that for each particular value of load there represented it is possible to substitute the corresponding heat input to the steam generating equipment. If this is done for all of the loads, there will result a B.t.u.-input duration curve (Fig. 3). Inspection will show that integration of the area under this curve yields the total heat consumption of the combined equipment for the year considered. This value may be used to obtain pounds of coal per year if the average heat content of the coal used is known.

Generally as equipment ages its loading is decreased. Therefore, if the machine load-duration curve is for a year of favorable machine loading, it is necessary by some means to correct the annual coal consumption derivable therefrom for conditions more likely to obtain for average loading conditions over the entire equipment life. The problem of setting up a great number of load duration curves that will take care of this condition is so complicated and perhaps even so impossible of accomplishment that it is suggested that a factor which might be termed the "use-expectancy factor" be assumed or developed and applied directly to give an approximate "effective average" annual coal consumption.

After the effective average coal consumption has been derived the operating cost may be determined by applying the average coal cost expected over the operating life of the equipment.

Basis for Calculating Annual Carrying Charges

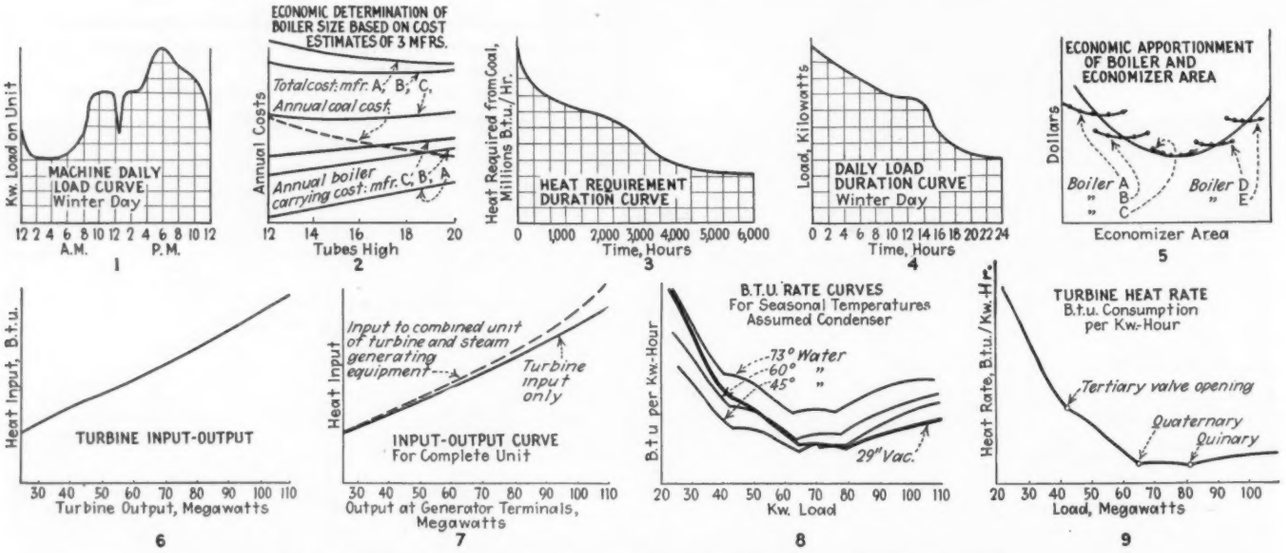
After the equipment investment is determined the rate at which to figure carrying charges per annum should be developed. This rate includes interest, taxes, insurance, amortization and preferably an "incentive" factor. By "incentive" factor is meant that margin of safety which is justly applicable to investment in expensive or in new and untried apparatus to give it a very definite advantage. Once such a total rate is established, it may be applied to the investment to derive an annual carrying charge. Or for direct comparison of investments, the annual operating costs may be capitalized by dividing them by the annual carrying charge rate.

If the coal cost based on the effective average coal consumption is capitalized and added to the investment cost, the result will in all normal cases represent the major part of the total charge assignable. Certain other considerations may be favorable or unfavorable. For example, one design of turbine may permit much less surrounding floor space for the stowing of disassembled parts during repair periods, or certain equipment may hold forth alluring possibilities, the true merit of which must be ascertained before starting the construction of a new station, etc. Evaluation thereof may be either rational or arbitrary, and no generalization can be made.

The summation of the capitalized coal cost, the investment cost and all additional evaluations will result in a single money value representing the charge against any one kind of development or equipment. If for several developments or equipments this same general process is followed, the results may be compared.

To illustrate the principles laid down a part of the analysis of proposals for the No. 5 turbine-generator for Hudson Avenue will be reviewed.

The general belief existed that the largest capacity machine that could be practically installed and supplied with steam would be justified on the dual grounds of immediate reduction of cost per kilowatt installed and of postponement of future capacity installation. It was recognized in laying out the design that the limitation in carrying out this general principle would be in the boiler room rather than in the turbine room. In the boiler room the building columns had already been erected and the stoker area which it was possible to install was by this fact definitely established. After a survey of the situation it was believed that for emergency conditions it would be possible to generate on the amount of boiler plant which could be allocated to the service of this unit and which would probably be capable of being called on in a time of emergency a total of 1,200,000,000 B.t.u. per hour. Further, at time of peak load and with hot circulating water, it was felt that approximately a 27¾-in. vacuum could be maintained. Therefore the turbine manufacturers were advised that it would be possible to supply to the turbine a total of 1,200,000,000 B.t.u. per hour to be utilized between the throttle and a 27¾-in. turbine exhaust condition and that a definite money premium


MACHINE DAILY LOAD CURVE Winter Day
Kw. Load on Unit
12 2 4 6 8 10 12 2 4 6 8 10 12
A.M. P.M.
1
ECONOMIC DETERMINATION OF BOILER SIZE BASED ON COST ESTIMATES OF 3 MFRS.
Total cost: mfr. A, B, C
Annual coal cost
Annual boiler carrying cost: mfr. C, B, A
Annual Costs
12 14 16 18 20
Tubes High
2
HEAT REQUIREMENT DURATION CURVE
Heat Required from Coal, Millions B.t.u./Hr.
0 1,000 2,000 3,000 4,000 5,000 6,000
Time, Hours
3
DAILY LOAD DURATION CURVE Winter Day
Load, Kilowatts
0 2 4 6 8 10 12 14 16 18 20 22 24
Time, Hours
4
ECONOMIC APPORTIONMENT OF BOILER AND ECONOMIZER AREA
Dollars
Boiler A
" B
" C
Boiler D
" E
Economizer Area
5
TURBINE INPUT-OUTPUT
Heat Input, B.t.u.
30 40 50 60 70 80 90 100 110
Turbine Output, Megawatts
6
Input to combined unit of turbine and steam generating equipment
Turbine input only
INPUT-OUTPUT CURVE For Complete Unit
Heat Input
30 40 50 60 70 80 90 100 110
Output at Generator Terminals, Megawatts
7
B.T.U. RATE CURVES For Seasonal Temperatures Assumed Condenser
73° Water
60° "
45° "
29" Vac.
B.t.u. per Kw.-Hour
20 30 40 50 60 70 80 90 100 110
Kw. Load
8
TURBINE HEAT RATE B.t.u. Consumption per Kw.-Hour
Tertiary valve opening
Quaternary
Quinary
Heat Rate, B.t.u./Kw.-Hr.
20 30 40 50 60 70 80 90 100
Load, Megawatts
9

FORM IN WHICH DATA ARE KEPT TO AID PROPER SELECTION OF POWER EQUIPMENT

Fig. 5—For each size of boiler, performance has been worked out for five different sizes of economizer. This performance when obtained would be expressed in terms of an efficiency curve. The efficiency curve would be applied to a boiler-load duration curve and an effective average annual coal consumption determined. With the cost of installing that particular size of boiler and economizer worked out, an annual total combined carrying charge and operating cost can be established for the particular size of boiler and economizer. This is indicated in Fig. 5 as the point farthest to the left on the curve for boiler "A." Holding the size of boiler "A" fixed, similar determinations would be made for four other sizes of economizer. The information resulting in each of these independent parts of the analysis would permit drawing the curve marked boiler "A." If then the size of boiler were to be decreased and performance of this new boiler jointly with five somewhat larger size economizers were to be determined, it would be possible to plot the curve for boiler "B." In like manner by decreasing the boiler size three times further it would be possible to plot the curves marked "C," "D" and "E." If then each of these five curves is independently inspected it will be seen that the lowest point on each curve indicates the economizer area which together with the particular boiler size is most advantageous. If these five "best points" are joined by one curve, the result shows the locus of best economizer areas for different boiler sizes. The best boiler area and the best economizer area to install can be determined from the lowest point on the final curve by noting the boiler area and the economizer area.

If the problem is complicated by the addition of an air preheater after the economizer, the method of attack can be shown in Fig. 13. Each one of the "families" of points represents a family of the kind just discussed. Taking any one particular group of five points joined by a curve, the boiler size and the economizer size have been held constant, and performance determined with five different sizes of air preheater considered.

While continuing to hold the boiler size constant, the economizer has been changed and performance again determined for five different sizes of air preheater. By continuing this process for five different sizes of boiler, five sizes of economizer and five sizes of air preheater the final curve can be determined which relates the sizes of boiler, economizer and air preheater best suited to the combination.

would be given for each kilowatt of extra capacity securable from one machine over another at this heat consumption.

The premium per kilowatt was admittedly a somewhat arbitrary factor. In general the philosophy underlying its establishment was that kilowatts in the maximum range of the machine would not be usable for approximately two years and that an ultimate value figure per kilowatt installed could be discounted 20 per cent per annum carrying charge for two years, making for a 40 per cent discount and resulting in a 60 per cent present worth of each kilowatt of capacity usable two years from date.

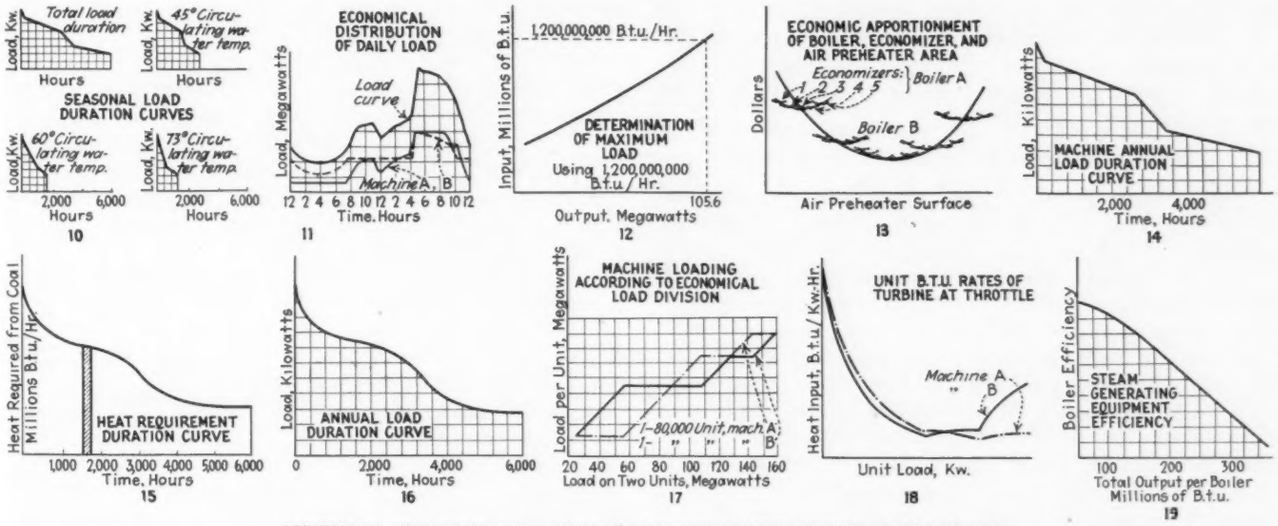
Load-Duration Curve Helps Evaluation of Different Proposals

On this equipment there were a total of fourteen different proposals, the differences between which had to be evaluated in terms of money for report to the purchasing agent. To permit a comparison of these fourteen possibilities, a machine load-duration curve (Fig. 14) was made up representative of what it was felt would approximately prevail in the year of maximum machine loading. To reduce all the results obtained by its use to results corresponding to an approximate "effective average annual value," a "use-expectancy factor" of 70 per cent was derived.

An example will be chosen from that part of the work done in connection with determining which of two exhaust areas offered by one manufacturer should be purchased. For this work vacuum had to be taken into account, inasmuch as the turbine guarantee was based on 29-in. vacuum conditions, which could be maintained throughout but a very limited portion of the year. The principal factor affecting condenser vacuum, independent of the condenser characteristic and loading, is circulating water temperature. To account for the seasonal differences in circulating water temperature, the load duration curve was subdivided into three parts representative of three seasons with 45 deg., 60 deg. and 73 deg. circulating water temperatures (Fig. 10).

In the absence of knowledge as to what condenser size would be used, an arbitrary size assumption was made and the performance with 45 deg., 60 deg. and 73 deg. water was estimated from performance obtained on existing condensers in the station. By working jointly with the turbine vacuum correction data supplied by the manufacturers and with the condenser performance, turbine B.t.u.-rate curves (Fig. 8), corrected for the actual expected vacuum at each load with each water temperature, were determined. The break in the 45 deg. water rate represents a change in B.t.u.-rate incidental to an assumed changeover from low to high speed on the circulating pumps.

Using the three seasonal load duration curves and the turbine B.t.u.-rate guarantees as corrected for the three water temperatures, the average annual coal consumption was determined for the exhaust size just considered.



ADDITIONAL GRAPHICAL DATA THAT PERMIT INTELLIGENT CHOICE OF APPARATUS

Fig. 18—If all of the loading of machine "A" had been conceived of as being below 53,000 kw., then machine "B" would have been a superior one to purchase. Conversely if the loading had all been above 53,000 kw., then machine "A" would have been the superior one to purchase. As respects the effect of the machine B.t.u.-rate curve on minimizing the capacity of the boiler plant required, machine "A" is unquestionably superior. The entire problem in this case is to weigh the inefficiency of machine "A" in the light-load range, the better efficiency in the high-load range and the effect of the maximum load efficiency on boiler plant capacity. No assumption of average load will permit doing this. It can be done only by proportioning the running hours of various expected loads. Nor is it sufficient in proportioning the expected load as between high and low loads to assume that each machine under consideration will be loaded alike. To illustrate this statement, let it be assumed that machine "A" and machine "B" together will serve a certain definite load (Fig. 17). It can be seen that quite different individual machine loads should be assigned to the two machines. With such differences of load distribution possible load division cannot be neglected.

In addition it was essential to take account of the ability of that size exhaust end to produce load with a 27¾-in. vacuum for the given total 1,200,000,000 B.t.u. per hour of heat supplied to the turbine. To make this determination the manufacturer's 29-in. vacuum guarantee B.t.u.-rate curve was drawn first, then to this was applied the vacuum correction for a vacuum of 27¾ in. Next, from the turbine heat-rate curve as corrected for 27¾-in. vacuum, the 27¾-in. vacuum turbine heat input-output line (Fig. 12) was developed.

Summary of Charges Prepared to Compare Bids

This work was then duplicated, using one of the machines with a different size of exhaust. When completed, a comparative summary of charges was drawn up, using the form indicated in the table on page 1240.

This preference was reported to the purchasing agent, who knew the difference in price of machines with exhaust areas A and B. The evaluated preference for exhaust area A dictated its purpose.

SUMMARY OF CHARGES

	Exhaust Area A, Sq.Ft.	Exhaust Area B, Sq.Ft.
Annual coal cost (effective average)	Item 1	Item 2
Maximum load, developed kilowatts	Item 3	Item 4
Difference in annual coal cost	0	Item 2 — Item 1
Difference in maximum load developed	Item 3 — Item 4	0
Capitalized charge for difference in annual coal cost at 15 per cent	0	Item 2 — Item 1 / 15 per cent
Capitalized penalty in maximum load developed at $M per kilowatt	0	(Item 3 — Item 4) × $M
Total penalty for exhaust area B over A	0	Sum of above two results

There has been a growing recognition of the importance of economically dividing load between different parts of an operating plant. Before making up an annual machine load duration curve for a particular piece of equipment the engineer should consider the proposed equipment jointly with all the other equipment on his system in relation to the system load. The entire system load has to be proportioned economically between the available equipment, giving due consideration to all the factors affecting load division. This done, the particular load available to the new equipment under consideration should be segregated from load to be assigned to other equipment.

Development of Load Duration Curves

The starting point for this work is the system-load duration curve. The development of this is of extreme importance and in most companies is assigned to a statistical division, where minute study is given to all matters having any bearing on the problem. The system-load curves predicted are based on records of past years modified by such influences as can be observed and studied. Building and financial conditions, census and meter statistics and such possibilities as the addition of large blocks of power which would materially change both the size and shape of such load curves are only a few of the factors that must be considered in preparing these forecasts. It must be frankly recognized that despite the best attention and the highest caliber of men preparing load duration curves, they cannot have the precision of a table of logarithms, particularly because they attempt to project themselves nearly a score of years distant.

The engineer, in the idealized evaluation, will take the results of the statistician and build further on these to prepare individual machine-load duration curves for the future period covered. The ideal execution of this work involves having in addition to a reasonably accurate prediction of future load during the life of the particular equipment a rather complete knowledge of the operating economy of every piece of equipment on the system, the expected economy of the proposed equipment and, beyond that, the probable economy of the future installation to be made during the life of the particular equipment under consideration.

Difficulties will attend the work. For example, the practical operating economy of all existing equipment is sometimes not precisely known, and the expected economy of proposed equipment, where such does not exactly duplicate existing equipment, necessarily can be only approximate. Operating contingencies entirely beyond human control likewise have a most important bearing on what load will be given particular equipment. Changes in operating practice, or even in general company policy, as for example with reference to intercompany electrical ties, made subsequent to a decision on proposed equipment, can grossly influence what the future actual load division will be as compared with the estimated load division.

In the light of all this, many engineers question the justification even of an attempt to predict a future load duration curve. The question may be raised, Why trouble with attempts at prediction of a load duration curve and why not simply assume a fair average load for whatever equipment is to be installed? If reference is made to Fig. 18, it will be seen it may be quite essential to take into account the running hours at different loads.

Expected Performance Data

Determination of the general type of plant development to be followed and the size of equipment to be installed, and the evaluation of a number of competitive bids made by different manufacturers after a particular type of plant has been decided on are two important problems. In both classes of work it is necessary to have expected performance data with which to work. The principal difference in the two cases is the basis for the expected performance data.

In the preliminary analyses it is the practice to secure from every source possible whatever information can be had relating at all to the problem in hand. By breaking down such information to as few fundamental constants as possible it has frequently been possible to construct a probable performance of an assembly of equipment quite different from any complete assembly from which data as to the component parts were drawn.

In evaluating competitive bids made by different manufacturers, the practice, as set forth on page 1255 of this issue, is to take the performance guarantees of reputable manufacturers at their face value without any corrections for probable or possible differing margins of safety that may be claimed. Occasionally guarantees come in that are so far out of line with usual performance that apparently some error in calculation has been made. Such apparent discrepancies are called to the attention of the manufacturer for correction or justification.

This Method Helps Disclose Discrepancies in Proposals

Two cases of this kind are cited. A stoker company had its guaranteed performance on a stoker distributed over two curve sheets. When this information was transmitted to a boiler company to be incorporated in an over-all guarantee of stoker, boiler and economizer, the stoker company failed to send to the boiler company the second curve sheet, which carried on it the very important statement that the soot loss at maximum coal-burning rate on the stoker would be 7 per cent. The boiler company made up and actually guaranteed the over-all performance omitting a 7 per cent loss at the maximum rating—that is, it guaranteed too high to the extent of seven points in efficiency at maximum rating. The error was discovered just a few hours in advance of the engineers making their final recommendations for purchase. Another case arose in which a manufacturer, bidding on feed-water heaters, guaranteed a pressure drop through the entire heater less than was known to be the pressure drop through straight tubes the length of the tube bid on. Thus a negative allowance had been made for water box losses and tube inlet and outlet losses.

Whether the utility engineers are setting up the expected performance data or a manufacturer is doing this same work, it is most important when comparing

performance of one combination of equipment with a different combination to make certain first that the most optimistic apportionment of sizes is obtained in each combination. The proper execution of this principle often entails an exhaustive amount of labor.

To be specific, let it be assumed that a comparison is to be made between two types of boiler plant, one to contain boilers and economizers, the other to contain boilers, with economizers, and with air preheaters in addition. If a significant answer is desired it will by no means suffice to make an arbitrary assumption of sizes. Each plan requires a very complete economic study to determine what proportions of boiler and economizer and air preheater make the best combination for the specific conditions to be met. This work has to be done in advance of making a comparison of the one plan of development with the other.

To illustrate how the problem may be attacked, reference should be made to Fig. 5.

Determination of Installation Costs

Determination of installation costs is not as simple as it might seem. The difficulties which may develop were illustrated in designing No. 5 unit for the Hudson Avenue station when an attempt was made to establish an approximate idea of the economic size of boiler to install. Through the purchasing agent of the Brooklyn Edison Company approximate prices were secured from three of the leading boiler builders. The prices secured are shown relatively against boiler height in Fig. 2. On receipt of the prices it was recognized they could not be used seriously and that any attempt at determination of economic sizes would be futile. However, simply to show the absurdity of using the quoted prices blindly as a basis for size selection, a hasty analysis was made to show the combined annual carrying charge and operating cost with the different makes of boilers (Fig. 2). The boilers offered by the three builders had the heating surface disposed in the same manner and were as nearly identical regarding items which would affect performance as mechanical equipment built by different builders could be.

As a result of this experience, when specifying the steam-generating equipment, sizes are not now specified. Instead, the conditions under which the equipment is to be installed are very specifically named, together with a basis by which each manufacturer can determine for his equipment the selling prices that would be most advantageous to offer.

Substation Maintenance Truck

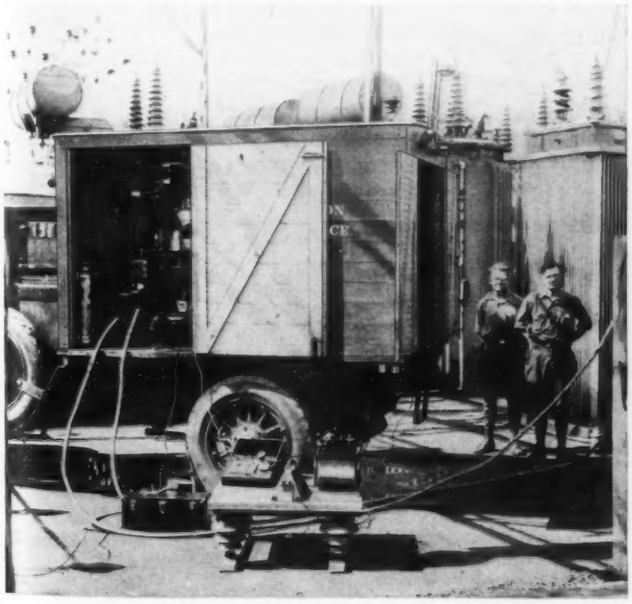
By R. L. Boisen
Electrical Engineer Lake Superior District Power Company, Ashland, Wis.

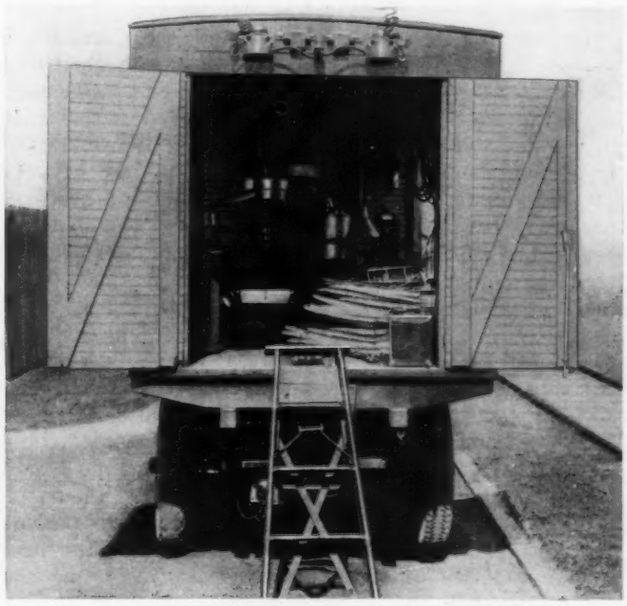
A TRUCK equipped to handle all of the usual substation maintenance and route testing is employed by the Lake Superior District Power Company and Northern division of the Michigan Gas & Electric Company. Testing and purification of transformer oil, replenishment or changing of oil, inspection of lightning arresters and testing ground resistances are among the chores performed by the two men who constitute the crew of this vehicle.

This truck has been a great time-saver. Besides being of value in the maintenance of company substations, it also helps to create good will with the larger customers. Whenever the truck is operating in a territory in which are located one or more industrial substations, it is the company's practice to offer to do the maintenance work in the customer's substation and to charge for that work only enough to cover the time of the two men on the truck. This practice has had a very favorable reaction.

In one case the job of oil purification was done at a cost to the customer of less than $20. A couple of years previously the same job had been done for the same customer at a cost of $80. However, the first time the job was done the truck was not yet in existence, which explains the difference in the two figures for the performance of identical jobs.

All the wiring to the testing transformer, oil-purifying outfit and outlets required for the portable testing equipment is run in conduit. Connection with overhead 2,300-





MAINTENANCE TRUCK ON THE JOB SHOWING OIL PURIFYING EQUIPMENT

Substation Maintenance Truck Equipment

One No. 4 super-centrifuge oil purifier, capacity 400 gal. per hour.

One 7½-kw. transformer, which is used for driving the motor, supplying current for the heater, and also for supplying current for the high-tension testing outfit and the ground-testing outfit.

One portable oil-testing outfit. This has a voltage range of from 15,000 to 25,000 volts.

One ground-testing outfit used for testing substation grounds. This is the type of outfit recommended by the Railroad Commission of Wisconsin.

Four 50-ft. lengths of 1-in. flexible metal hose.

Thirty feet of ¾-in. galvanized iron pipe.

Miscellaneous pipe fittings.

One high-tension switch stick. This switch stick consists of three 6-ft. pieces, making total length 18 ft. The reason for dividing it into three pieces is to provide room in the truck for it.

One full barrel transformer oil.

One empty transformer oil barrel.

One Prest-O-Lite soldering outfit.

One set of gages used for checking spark gaps on lightning arresters.

One 3-gal. pail.

One funnel.

One sledge hammer used for driving ground rods.

Ten 8-ft. x ¾-in. copper-welded ground rods. These rods are used in testing grounds. To test grounds two ground rods are driven and the resistance is tested between these and the grounds used in the substation. This involves two tests, one for testing equipment grounds and one for testing lightning arrester grounds.

One full 5-gal. kerosene can. Kerosene to be used for cleaning.

One hand line.

One box tools.

One Foamite fire extinguisher.

Two Pyrene fire extinguishers. One of these is mounted inside of the truck and the other is mounted in the driver's cab.

Two pairs rubber gloves.

One rubber blanket.

Two raincoats and hats.

One first-aid cabinet.

volt circuits is made by means of a demountable bracket and the cutouts are mounted on the back of the truck. The 2,300-volt supply is carried to the primary of the transformer in high-tension cable installed in conduit. The secondary of the transformer is equipped with a standard cutout switch and a wattmeter.

Reducing Distribution Losses

THIRD ARTICLE

Distribution Transformer Loading

By J. B. Moorhouse
Electric Distribution Engineer Central Illinois Public Service Company, Springfield, Ill.

ONE of the factors involved in minimizing the losses in a distribution system is the correction of distribution transformer sizes. The following practices are suggested in order to select some basis for deciding the correct loading of transformers:

1. Allow peak loads up to the point where voltage regulation is a deciding factor.
2. Increase transformer loading to a point where burnouts from overload begin to occur.
3. Establish a 1 to 1 ratio between system peak load and total connected distribution transformer kilovolt-amperage.

In the State of Illinois the Commerce Commission prescribes for lighting service that during the hours of 5 p.m. to 11 p.m. voltage at the customer's meter shall not fall more than 4 per cent below normal or rise more than 5 per cent above normal. Assuming a normal pressure of 115 volts, the lighting peak limits are between 110 volts minimum and 121 volts maximum. From 11 p.m. to 5 p.m. voltage may vary 10 per cent above or below, placing the limits at 104 volts minimum and 126 volts maximum.

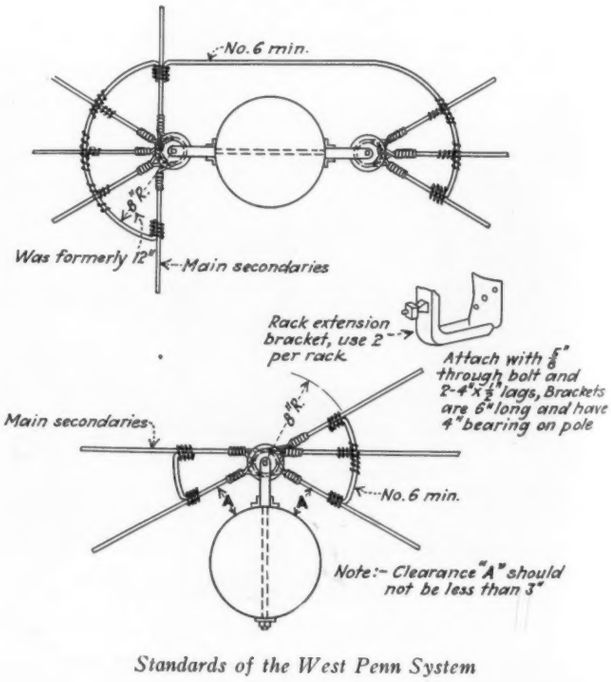
Large transformers have better regulation than small ones except at low power factor. If the regulation of a transformer is 2 per cent or more, it is readily seen that for short periods of overload voltage regulation is the deciding factor instead of temperature limits. If transformer loading is based entirely on voltage regulation, large transformers will be given a higher percentage load than small ones. In anticipation of a demand for transformers that will stand high peak loads for short periods of time, some manufacturers have increased the heat storage capacity of the transformer by increasing the size of the tank and quantity of oil.

If we increase transformer loading until burnouts begin to occur from overload, at what point shall we stop increasing load? If burnouts from overload per year are more than 1 per cent of the total number of transformers installed, the expense of repair or replacement will be excessive. If it is less than ½ per cent, we shall not be sure we have reached maximum loading conditions.

In deciding upon transformer loading on the basis of the ratio between system peak load and total connected distribution transformer capacity a single ratio of 1 to 1 will apply only in the best territory where load is concentrated. When numerous small towns are fed from a transmission system a ratio of 1 to 1½ may be considered very good.

The ratio of iron loss to copper loss in a distribution transformer of modern design is approximately 1 to 3 for the smaller sizes and 1 to 4 for the larger. This design is based on the facts that iron loss must exist 24 hours per day, whereas the copper loss exists for four to six hours per day. There are cases where transformers operate at full load for ten or more hours per day. In these cases transformer copper loss kilowatt-hours per day will be much higher than iron loss. Here a saving can be effected by increasing the transformer size.

Service-Line Connections


No. 6 min.
8'-0"
Was formerly 12"
Main secondaries
Rack extension bracket, use 2 per rack.
Attach with ⅝" through bolt and 2-4"x⅜" lags. Brackets are 6" long and have 4" bearing on pole
Main secondaries
8'-0"
No. 6 min.
Note:- Clearance "A" should not be less than 3"

Standards of the West Penn System

Calculation of
Sustained Short Circuits

Practical method for use with alternators to calculate three-phase and single-phase short-circuit currents. Simple formulas are given

By H. B. DWIGHT

Massachusetts Institute of Technology, Cambridge, Mass.

THE determination of the sustained values of short-circuit currents in power systems is becoming increasingly important. In many city systems circuit breaker relays are set to open instantaneously or in a small fraction of a second, but more widespread systems use much longer times for the settings of relays, thus producing the result that the current which the circuit breaker opens is the sustained short-circuit current. The use of sensitive voltage regulators with exciters that take a very short time to raise or lower their voltage brings the alternators sooner to their sustained condition, and so makes the circuit breaker duty dependent on the sustained short-circuit current in an increasing number of cases.

In this article are shown methods of utilizing generator characteristics in the calculation of sustained values of current for single-phase short circuits of several types as well as for three-phase short circuits.

Since the resistance of the generators, transformers and the power system network is much less than the reactance, the short-circuit current is substantially of zero power factor. The calculation of sustained short-circuit current is therefore the same as the determination of the zero power factor armature current of a generator when the field current and the external reactance are given.

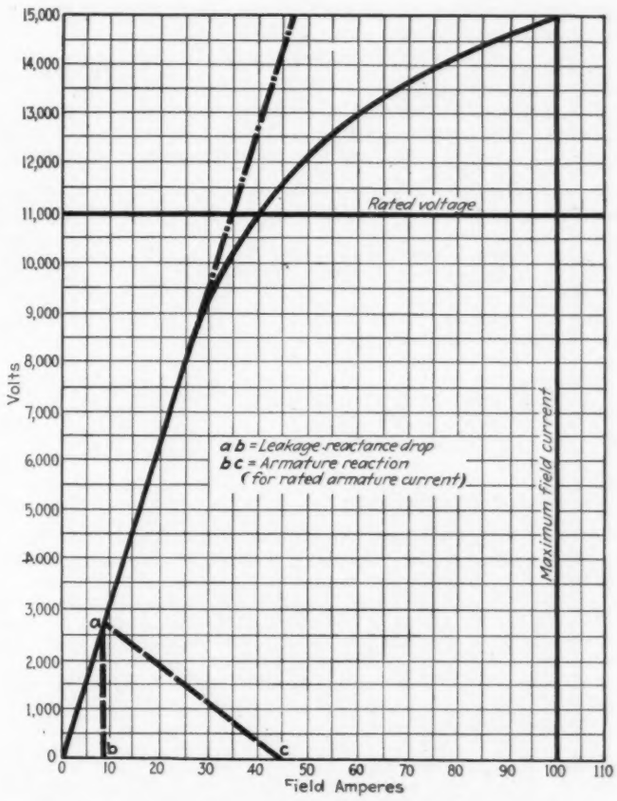
Generator Data Required

The generator data required are the no-load saturation curve, the armature reaction expressed in terms of field amperes and the leakage reactance drop. These can be obtained from the manufacturers, or they can be measured by comparatively simple tests. Leakage reactance, for the present purpose, is the reactance which when inserted in the generator vector diagram gives the field current for load conditions.

The zero power factor saturation curve of a generator at rated armature current, as determined by test, is often available. The readings of this curve can be calculated from the armature reaction and the leakage reactance, the same as three-phase short-circuit currents with external reactance, and in this way a check can be made on the data used for the calculations.

Three-Phase Short Circuits

In order to find the magnitude of the sustained three-phase short-circuit current for a given field current, a value of armature current is first assumed. Then the procedure is as follows: Multiply the armature current by the external reactance plus the generator leakage reactance and by 1.732 to give the total reactance drop, terminal to terminal. Read the corresponding field current from the no-load saturation curve. Add to this the field current for armature reaction, or demagnetizing armature ampere turns. The total field current will, in general, not be the same as the given field current, and new values of armature current must be successively assumed. The final value of armature current, the required field current of which is equal to the given field current, is the short-circuit current desired.



ALTERNATOR CHARACTERISTICS FOR SHORT-CIRCUIT CALCULATIONS

The given value of field current may be the value required at full load if the generator operates with fixed field current, or it may be the maximum field current which the exciter can furnish if an automatic voltage regulator is in use. In the latter case the generator terminal voltage, equal to the armature current multiplied by the external reactance and multiplied by 1.732, should

always be calculated. If it is larger than rated voltage, the solution just described does not apply, but the sustained short-circuit current will be equal to rated star voltage divided by the external reactance. The star voltage is equal to the voltage between terminals divided by 1.732 for three-phase generators. Care must always be taken to distinguish between voltages to neutral, such as current multiplied by line reactance, and voltages between terminals, as depicted on saturation curves.

Example I. Sustained Three-Phase Short-Circuit Current:
No load saturation curve (see illustration).
Rated armature current, 1,000 amp.
Leakage reactance drop at rated load, 2,800 volts, terminal to terminal.
Armature reaction at rated load equivalent to 36 amp. field current.
External reactance, 3.5 ohms.
Maximum field current given by automatic regulator, 100 amp.
For a first trial, assume 1,500 armature amperes.

Leakage reactance drop, (1,500 ÷ 1,000) × 2,800 =	4,200 volts,	terminal to terminal.
External reactance drop, 1,500 × 3.5 × 1.732 =	9,100 volts,	terminal to terminal.
Total drop =	13,300 volts,	terminal to terminal.
Field current for 13,300 volts =	65 amp.	
Field current for demagnetizing, (1,500 ÷ 1,000) × 36 =	54 amp.	
Total field current required =	119 amp.	

This is larger than the given field current, and so assume a smaller armature current.
The solution will be found to be 1,375 armature amperes.

Leakage reactance drop, (1,375 ÷ 1,000) × 2,800 =	3,850 volts,	terminal to terminal.
External reactance drop, 1,375 × 3.5 × 1.732 =	8,350 volts,	terminal to terminal.
Total drop =	12,200 volts,	terminal to terminal.
Field current for 12,200 volts =	51 amp.	
Field current for demagnetizing, (1,375 ÷ 1,000) × 36 =	49 amp.	
Total field current required =	100 amp.	

Example II. Sustained Three-Phase Short-Circuit Current:
Same data as for Example I, except 10 ohms external reactance.
By trial it will be found that the armature current requiring 100 amp. field current is 690 amp. This produces an external drop—that is, a terminal voltage—of 12,000 volts. This is greater than the rated value. The sustained short-circuit current, with the regulator maintaining the terminal voltage at 11,000 volts, will be 11,000 ÷ (10 × 1.732) = 635 amp. The field current will be 81 amp.
A comparatively large value of external reactance, as in Example II, is not uncommon in short-circuit problems. It corresponds to any case where a short circuit occurs outside of a transformer bank the rating of which is small compared with the combined rating of all the generators.
After two solutions have been obtained, one of which is slightly too large and one slightly too small, the final solution lying between them may be readily obtained by linear proportion.

When generators are scattered throughout a network, the network is not always equivalent to a single external reactance when simplified as much as possible by methods usual in short-circuit calculations. In such cases it may be necessary to assume armature currents for the various generators and alter them until the conditions of the network are satisfied.

Single-Phase Short Circuits

First, consider the case when current flows in only one phase of a star-wound three-phase generator. The pulsating, single-phase magnetic field set up by the armature can be considered to be the resultant of two revolving magnetic fields which go around the armature in opposite directions at synchronous speed. The component of the armature reaction which revolves along with the rotor and acts on one pole of the machine is, in the case of a pitch winding, *

$$\frac{NI}{\sqrt{2}} K_b \qquad (1)$$

where N is the number of turns per pole in that phase of the winding, I is the current in amperes, and K_b is the breadth factor. An approximate formula for breadth factor for armature reaction for machines of various types of field construction is the breadth factor formula used for the generated voltage—namely,

$$K_b = \frac{2}{\theta} \times \sin \frac{\theta}{2} \qquad (2)$$

where θ is the angle in electrical radians which the belt of winding covers, the number of slots being assumed large.* If the winding is chorded, expression 1 can be multiplied by the usual pitch factor.

In the present case, with current flowing in one phase of a star-wound machine,

$$K_b = \frac{6}{\pi} \times \sin \frac{\pi}{6} = \frac{3}{\pi} = 0.955$$

and the armature reaction of one phase is

$$0.675NI \qquad (3)$$

In the case of zero power factor currents, such as short-circuit currents, the current in the armature conductors is in lagging quadrature with the voltage produced by the field flux cutting those conductors. The effect of such a current is to demagnetize the field poles and directly oppose the ampere turns of the field winding.

Now, if three-phase current flows in the armature, the current in the second-phase belt is spaced 120 electrical degrees away from the first, and it comes to a maximum 120 deg. later in time, so that it is in quadrature with the voltage produced in the second phase belt by the field flux. The second-phase belt, therefore, produces a direct demagnetizing action on the field of $\frac{0.955}{\sqrt{2}} NI$ ampere turns. These are equal to the ampere turns of the first-phase belt and are superimposed on them and added directly to them. The third-phase belt adds an equal amount.

Therefore, when three-phase current of zero power factor, lagging, flows in a star-wound armature, the demagnetizing ampere turns are

$$\frac{3 \times 0.955}{\sqrt{2}} NI = 2.025NI \qquad (4)$$

If the star-wound generator is operating as a single-phase generator, with single-phase current in two of the belts and zero current in the third, the case is the same as for (3) except that the belt is now twice as wide and

$$K_b = \frac{3}{\pi} \times \sin \frac{\pi}{3} = 0.827$$

The armature ampere turns are

$$\frac{2 \times 0.827}{\sqrt{2}} NI = 1.170NI \qquad (5)$$

A somewhat similar result is given in the chapter on Armature Reactions in Alternators of "Electrical Machine Design," by Alexander Gray and P. M. Lincoln, McGraw-Hill Book Company.

In some of the cases of short circuit on the high-

*See "Principles of A. C. Machinery," by R. R. Lawrence, McGraw-Hill Book Company, equations 10 and 3.

tension side of star-delta transformer banks, single-phase current enters one of the terminals of a generator, divides at the neutral and half goes out of each of the other terminals. If $2I$ enters one terminal and I comes out of each of the two others, the current being single phase, zero power factor, lagging, the demagnetizing action is due to I in a belt of π radians, along with I in a belt of $\frac{\pi}{3}$ radians centrally spaced with respect to the wide belt. The armature ampere turns for this condition are

$$\frac{3}{\sqrt{2}} NI \times \frac{2}{\pi} \times \sin \frac{\pi}{2} + \frac{1}{\sqrt{2}} NI \times \frac{6}{\pi} \times \sin \frac{\pi}{6}$$

$$= 1.350NI + 0.675NI = 2.025NI \qquad (6)$$

The internal voltage of the generator when carrying the above type of load may be found by means of equation 1 of the article by W. W. Lewis published in the *General Electric Review* of April, 1925. The articles by A. P. MacKerras in the same magazine for April and July, 1926, are useful for calculating single-phase currents in networks.

When the armature reaction of a generator is known for three-phase current, the armature reaction for single-phase current can be obtained by multiplying by the appropriate factor, as follows:

For single-phase current between one terminal and neutral, multiply by

$$\frac{0.675}{2.025} = \frac{1}{3} \qquad (7)$$

For single-phase current between two terminals multiply by

$$\frac{1.170}{2.025} = \frac{1}{\sqrt{3}} \qquad (8)$$

For single-phase current of twice rated amperage entering one terminal and dividing equally between the two other terminals, multiply by

$$\frac{2.025}{2.025} = 1 \qquad (9)$$

Equation 4 is much used in design work and has been frequently checked by test and calculation within ordinary limits of accuracy. A check on equations 3 and 5 has been given by a test on a generator, upon which was put a sustained short circuit on one, two and three legs. The field currents for rated armature current were measured and were 97, 171 and 256 amp. Allowing for the self-inductance—that is, leakage reactance—drop in the winding, the calculated values for the first two, based on the reading 256 amp. and equations 3, 4 and 5, are 105 and 164 amp., which is a reasonably close check.

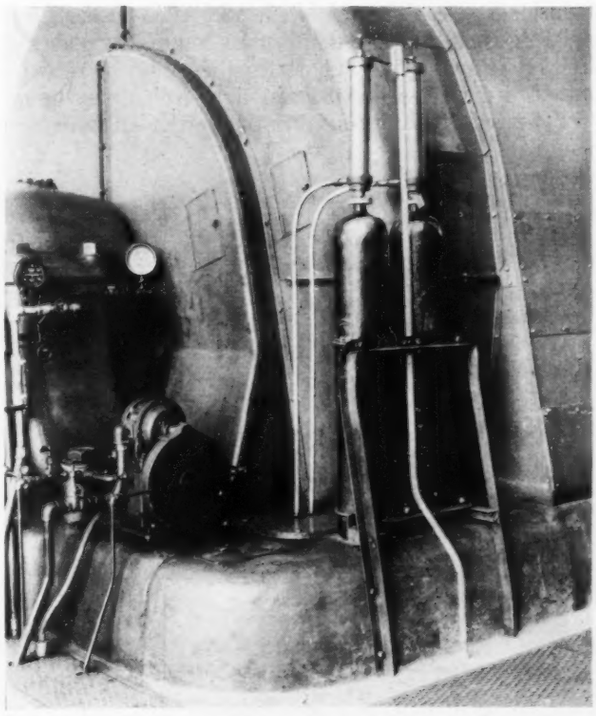
These calculated values were obtained as follows: The leakage reactance drop of this generator was 15 per cent, and 15 per cent of rated voltage at no load required 29 amp. The demagnetizing ampere turns for rated three-phase load are therefore $256 - 29 = 227$ amp. The demagnetizing ampere turns for single-phase armature current of rated amperage are $227 \times (1.170 \div 2.025) = 131$ amp. The developed voltage between terminals is 30 per cent of rated star voltage, or $30 \div 1.732 = 17.3$ per cent of rated terminal voltage. The field current needed for this internal voltage is $29 \times (17.3 \div 15) = 33$ amp., and the total field current for this single-phase load is $131 + 33 = 164$ amp. This is to be compared with 171 amp. measured.

In the case of the other single-phase load, of rated current in one phase from neutral to terminal, the field current for the internal voltage is 29 amp., and the demagnetizing ampere turns are $227 \times (0.675 \div 2.025) = 76$ amp. The total field current is $76 + 29 = 105$ amp. The total field current as measured amounted to but 97 amp.

By using the above formulas for armature ampere turns, the field current for a given single-phase load of the types described for various terminal voltages can be found by a direct calculation. In the case of zero power factor current, the total field ampere turns are equal to the field ampere turns required for the internal voltage of the generator, as taken from the no-load saturation curve, plus the demagnetizing ampere turns of the armature. For other power factors than zero a vector diagram calculation is needed, as usually used with the cylindrical rotor theory. If it is desired to find the value of armature amperes and voltage for a given field current, a trial and error calculation must be made. Various values of armature current are tried and the field current for each is calculated, until an armature current is found which has the given field current, as described in detail for three-phase short circuits.

The solution that has been given for single-phase currents in three-phase generators is reasonably accurate. It is useful for short-circuit calculations, because it depends on simple formulas applicable to both salient pole and turbo-generators and because it utilizes generator data that are usually available.

CO_2 Fire Protection on 50,000-Kva. Synchronous Condenser



Two cylinders are mounted at each corner of the machine as shown. Carbon dioxide gas is released into an inclosed air chamber either automatically or manually in case of fire in the machine. An automatic timing contactor releases cylinders of gas at predetermined intervals to maintain the proper saturation of gas over a period of time. This installation is at the Laguna Bell substation of the Southern California Edison Company.

Station Attendants Rewarded for Good Housekeeping

KEEPING apparatus and company property clean and orderly is made the basis of good-housekeeping awards by the Pacific Gas & Electric Company. The award is in the form of the bronze plaque which is placed in the premium station.

Operating property is divided into three classes—hydro-electric stations, steam plants and substations—for the purpose of a yearly contest. Each class has a first, second and third prize, and there is a grand prize for the best kept station on the entire system. The men themselves select the winner in each class in each territorial division and a general office committee makes the division awards. The winner of the grand prize is permitted to display a floodlighted sign, which may be seen by the public, announcing that the particular station was awarded grand prize over all others for good housekeeping. The idea has been in effect only a year, but already there is a very noticeable improvement in the appearance of station property and apparatus.

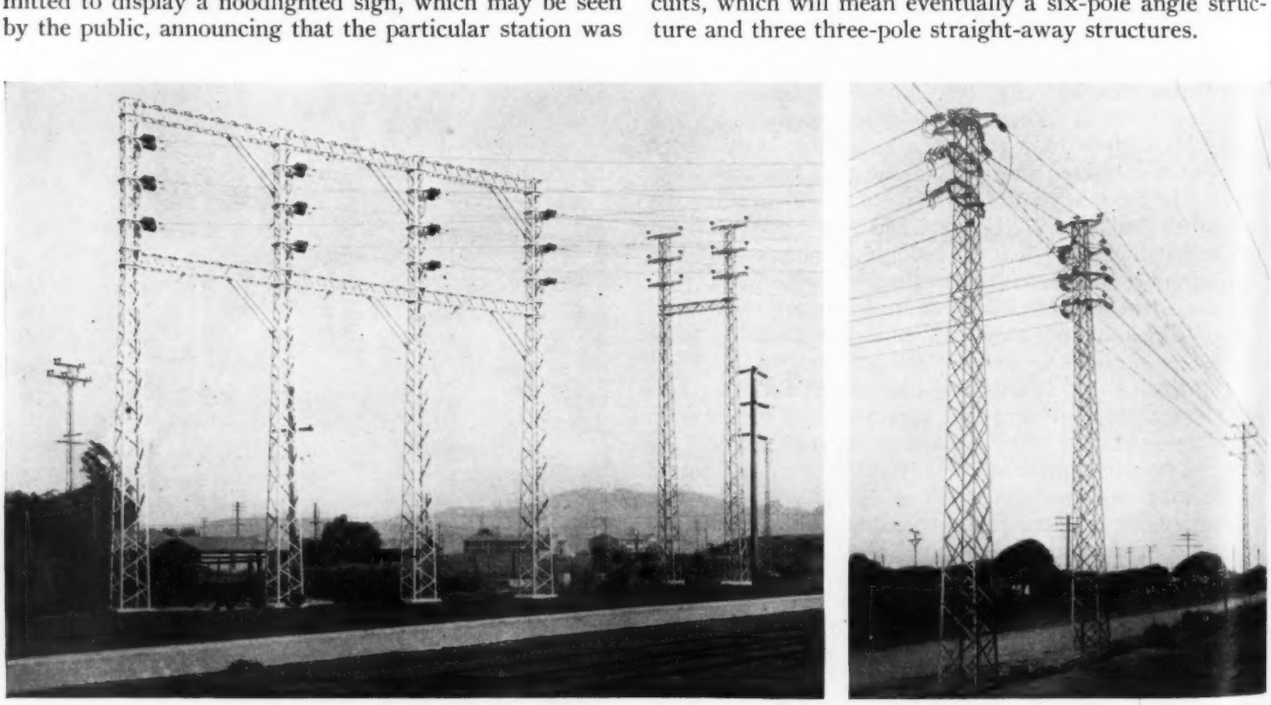
BRONZE PLAQUE AWARDED TO STATIONS FOR NEAT AND ORDERLY APPEARANCE

Steel Poles Used for Appearance and Durability

AT ITS important substations the Southern Sierra Power Company, Riverside, Calif., uses self-supporting steel poles similar to those shown in the accompanying illustrations for supporting the 33-kv. lines from the substation to a point outside the station yard. The four-pole structure is set at right angles to the incoming lines on two-pole structures to serve as a dead-end and also to separate the circuits in their approach to the substation.

This type of construction is used not because it effects economies but for the sake of appearance and durability. The conspicuous position occupied by these poles at the company's most important substation at San Bernardino, Calif., warranted consideration and, moreover, for the sake of appearance, it was desired to avoid the use of guys where the take-off angles occurred.

The average weight of the poles is 2,900 lb. each. The two-pole structures are 57.5 ft. high and have 8-ft. stubs. The poles in the four-pole structure are 49 ft. high and have 6-ft. stubs. The stubs are set in concrete with an average of 3.9 yd. of concrete per pole. The average cost per pole was: excavation, $5.70; concrete, $56.50, and steel, $230, making the total cost per pole, including labor, material, overhead and indirect charges, $292.20. Wood pole construction could have been used at a much less cost, but it would have meant the use of many guys and would have lacked permanency. The particular steel poles used are somewhat heavier than would be used for line construction, since they are entirely self-supporting, taking the dead-end strain of No. 2/0 copper conductors. The layout provides for the addition of two more circuits, which will mean eventually a six-pole angle structure and three three-pole straight-away structures.



SELF-SUPPORTING STEEL POLES CARRY 33-KV. CIRCUITS AWAY FROM IMPORTANT SUBSTATIONS. LEFT, FOUR-POLE ANGLE STRUCTURE AND TWO-POLE STRAIGHT-AWAY CONSTRUCTION. RIGHT, CORNER-POLE CONSTRUCTION

Selling Power
in a Diversified Industrial Territory

Plan based upon a census of non-customers in utility territory produces 1,700 per cent increase in connected horsepower in fifteen years

By H. H. HOLDING

General Power Representative Public Service Electric & Gas Company, Newark, N. J.

NEW JERSEY is a manufacturing state. In value of manufactured products it ranks sixth among the states of the Union. In value of product per unit of area it ranks third. The manufacturing plants are located in or near the larger cities and towns, so that in a strip of territory about 15 miles wide and extending diagonally across the state from the Hudson River to the Delaware River there was used for manufacturing purposes in 1926 approximately one and a third million primary horsepower. The total power used in the territory has increased 100 per cent in fifteen years, while the power supplied by the Public Service Electric & Gas Company has increased by nearly 1,700 per cent, or from 50,000 hp. to 890,000 hp. (July, 1927).

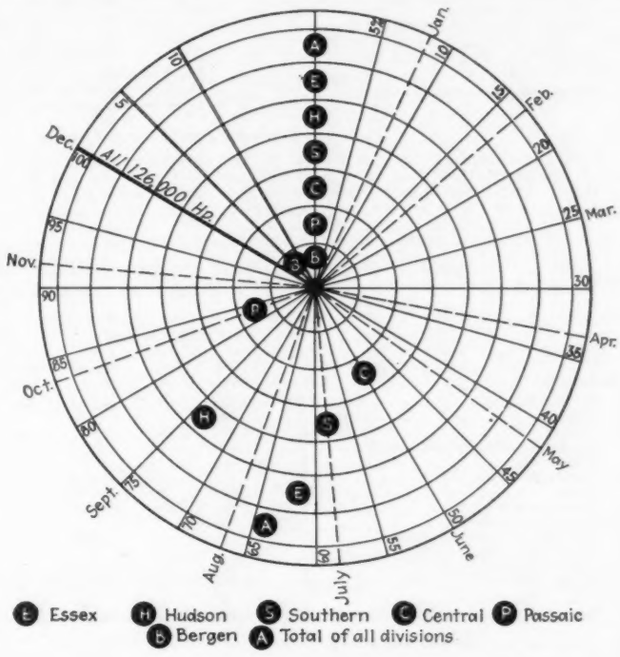
In 1910 the Public Service Electric Company (now the Public Service Electric & Gas Company) was supplying energy to approximately 50,000 hp. of motors in the strip of territory mentioned. The type of service was direct current and single-phase alternating current. With the inauguration of polyphase distribution in 1910 a power sales corps was organized. In the beginning ten power salesmen were assigned to cover the whole territory, composed of six divisions, each including several districts. This organization has been increased to 26 men, nearly all of whom are technically trained. These men spend all their time in selling power and have sold more than 840,000 hp. net gain in connected load in fifteen years.

At the start the conversion of a manufacturer to the use of central-station energy was a difficult task, which required many interviews, tests of operating conditions and voluminous reports. Each of the six Public Service divisions was supplied with a steam engine indicator. The power representatives were required to be familiar with this and other testing apparatus. The calculation of indicator diagrams and the analysis of data were necessary in nearly every case, as there were many belt-driven factories.

POWER CENSUS OFFERS BASIS FOR SALESMEN'S ACTIVITIES

It was soon found that complete information concerning the power used in the various districts was not available. A census was suggested, and in 1912 a "census taker" was put to work upon a complete systematic power census of the Newark district.

The work required several months, as only one man was used. The data were tabulated on industrial power classification sheets as illustrated. A recapitulation sheet for the district carried forward the totals obtained, under the headings of private electric plants and belt drive and combination plants in each of the 55 sections into which the Newark district was divided. The sections were indicated by outline and number on a Geological Survey map and the location of each prospective consumer was spotted on this map by means of colored stickers of three shades indicating the capacity for potential consumption as: red, 50 to 200 hp.; blue, 201 to 1,000 hp., and green, 1,001 hp. and higher. A data card was filled out for each power user, with such information as was available. Sometimes the information was refused by the power user and in many cases only meager information was actually available.



DIVISION PROGRESS CHART

The status of each division may be quickly noted by the use of this device. Movable markers bearing a designating letter are shifted to indicate the results achieved. Circumferential divisions mark percentages of bogie and indicate the month of the year when this progress should have been reached.

Individual records of data regarding each non-power customer are now kept on a sheet as illustrated and are developments of the original card, which carried much less detailed information. On the reverse side is the record of calls made by the representatives from time

E 348 500-4-13

INDUSTRIAL POWER CLASSIFICATION

DISTRICT_____ DIVISION_____ DATE_____

BUSINESS	PRIVATE ELECTRIC PLANTS								BELT DRIVE AND COMBINATION PLANTS								TOTAL	
	Number of Users				Horse Power				Number of Plants				Horse Power				No. of Plants	Horse Power
	No. 1	No. 2	No. 3	TOTAL	No. 1	No. 2	No. 3	TOTAL	No. 1	No. 2	No. 3	TOTAL	No. 1	No. 2	No. 3	TOTAL		
AMUSEMENTS																		
BUILDING CONTRACTORS																		
BREWERIES																		
BAKING																		
BRUSHES																		
BUTTONS																		
CHEMICAL WORKS																		
CLAY WORKING																		
COAL & ORE HANDLING																		
CONFECTIONERY																		
CORK																		
DAIRY PRODUCTS																		
ELEC. MACH. & SUPPLIES																		
ELECTRO-PLATING																		
ENAMELING																		
EXPLOSIVES																		

CLASSIFICATION SHEET FOR CENSUS

Information concerning each district was classified according to character of industries, showing, for each commercial group, such data as are indicated. A similar sheet offered the same type of data for district sections.

Figures have the following meaning: (1) 50 hp. and below, (2) above 50 hp. up to 200 hp., (3) above 200 hp.

NON-POWER CUSTOMER

DISTRICT_____ 192__

Name of Firm_____ Name of Manager or Executive_____

Address_____ Business_____

Boilers—Number_____

Total HP_____

Type_____

Pressure_____

Engines:_____

Total HP_____

Type Oil_____ Gas_____

Condensing_____

Generators—Number_____

KW DC_____

KW AC_____

Volts_____

Phase_____

Frequency_____

Belted or direct connected_____

Estimated friction loss which can be eliminated (HP)_____

INDIVIDUAL PLANT CENSUS DATA SHEET

Each non-customer was reported to the power representatives' file by a card similar to this. Full information was obtained where possible. The reverse side carries a record of calls and an outline of the information obtained by the power representative. Analysis of individual plant conditions and requirements also requires a record of number of motors and their total horsepower; total kilowatt-lights; maximum five-minute peak in kilowatts; average demand kilowatts, hours operation, day; kilowatt-hours per month; any night operation, total employees, normal; entire electrification or partial; future plans; fixed charges; operating charges; cost and kind of fuel; total cost cents per horsepower or kilowatt-hour; steam used in process; will low pressure do? Is refuse used under boilers? How much capacity necessary in emergency? Best demand and consumption and insurance needed against emergency; necessary direct current horsepower; general attitude of prospect; can production company be of service? Salvage value of plant; any use for electricity or gas where now not used and whether turbines or reciprocating units are used.

TABLE I—NON-CUSTOMERS' CONNECTED LOAD CENSUS, CLASSIFIED BY INDUSTRIES, DEC. 31, 1926
PUBLIC SERVICE ELECTRIC & GAS COMPANY

Industries	A Div. No. Non-Cust.	A Div. Connected Hp.	B Div. No. Non-Cust.	B Div. Connected Hp.	C Div. No. Non-Cust.	C Div. Connected Hp.	E Div. No. Non-Cust.	E Div. Connected Hp.	D Div. No. Non-Cust.	D Div. Connected Hp.	F Div. No. Non-Cust.	F Div. Connected Hp.	Total State No. Non-Cust.	Total State Connected Hp.
1. Metal working	72	16,329	24	14,765	11	4,618	18	28,401	1	3,400	28	26,360	154	93,873
2. Rubber	3	322	1	620	3	1,200	3	5,875	..	.....	5	1,460	15	9,477
3. Textile	8	4,407	19	6,471	66	36,933	3	1,400	2	1,870	12	9,079	110	81,160
4. Electric machinery and supplies	2	11,440	3	2,253	..	.....	1	17	1	98	..	.....	7	13,808
5. Wire works	3	400	..	.....	2	1,835	1	5,000	..	.....	1	500	7	7,735
6. Chemical works	7	5,675	12	3,250	8	3,938	11	16,185	3	5,281	2	175	43	34,504
7. Paper	8	2,015	8	3,135	3	675	2	725	6	4,355	4	2,481	31	13,386
8. Refrigeration	6	3,566	15	8,556	1	400	2	250	3	410	10	1,697	37	14,879
9. Incandescent lamps	..	.....	..	.....	..	.....	..	.....	..	.....	..	.....	..	.....
10. Shipbuilding and dry dock	..	.....	1	290	..	.....	..	.....	..	.....	2	470	3	760
11. Oxygen and byproducts	..	.....	..	.....	..	.....	..	.....	..	.....	..	.....	..	.....
12. Leather manufacturers	7	810	2	675	1	250	..	.....	..	.....	5	4,950	15	6,685
13. Foodstuffs	10	4,938	6	2,603	1	375	3	725	2	9,495	6	2,240	28	20,376
14. Coke and byproducts	1	50	1	290	..	.....	2	2,780	2	998	..	.....	6	4,118
15. Water works and pumping	1	335	1	2,270	1	500	3	1,250	1	4,270	7	4,597	14	13,242
16. Smelting and refining	..	.....	..	.....	..	.....	6	22,022	1	274	1	60	8	22,356
17. Railways (not now electrifications)	..	.....	3	3,465	..	.....	..	.....	1	1,150	2	9,480	6	14,095
18. Clay working	..	.....	1	1,000	..	.....	8	3,990	..	.....	16	1,877	25	6,867
19. Paint	3	1,575	2	600	1	150	2	545	..	.....	1	125	9	2,995
20. Oil and oil products	4	733	8	11,600	1	200	7	2,300	2	2,225	4	2,625	26	19,683
21. Woodworking	10	666	9	1,360	4	795	6	2,900	..	.....	10	18,370	39	24,091
22. Oil cloth and linoleum	..	.....	..	.....	1	625	..	.....	1	1,400	2	3,240	4	5,265
23. Stone, sand, concrete, etc	1	150	1	375	4	805	3	1,995	..	.....	..	.....	9	3,325
24. Building contractors	1	75	1	900	..	.....	..	.....	..	.....	..	.....	2	975
25. Cork	..	.....	..	.....	..	.....	..	.....	..	.....	..	.....	..	.....
26. Clothing and allied products	22	5,354	2	641	8	1,530	1	100	..	.....	3	1,245	36	8,870
27. Packing house	2	1,153	4	3,390	1	75	..	.....	..	.....	..	.....	7	4,618
28. Baking	3	780	3	685	..	.....	..	.....	..	.....	1	200	7	1,665
29. Telephone exchange and radio	..	.....	..	.....	..	.....	..	.....	..	.....	..	.....	..	.....
30. Novelties	6	570	2	250	3	2,407	2	450	..	.....	..	.....	13	3,614
31. Printing	1	200	1	150	..	.....	1	200	1	165	1	25	5	740
32. Celluloid and celluloid products	4	3,365	..	.....	..	.....	..	.....	..	.....	..	.....	4	3,365
33. Office building	10	4,185	6	3,214	1	425	4	529	..	.....	4	3,160	25	11,513
34. Buttons	5	265	..	.....	..	.....	1	150	..	.....	..	.....	6	415
35. Tobacco	1	60	2	1,310	1	40	..	.....	..	.....	..	.....	4	1,410
36. Electric corps. (redistribution)	..	.....	..	.....	..	.....	..	.....	..	.....	..	.....	..	.....
37. Dairy products	..	.....	..	.....	..	.....	..	.....	..	.....	..	.....	..	.....
38. Hotels	1	170	..	.....	..	.....	..	.....	..	.....	..	.....	1	170
39. Leather goods	..	.....	1	100	2	630	..	.....	..	.....	4	1,775	7	2,505
40. Asbestos goods	1	700	1	550	..	.....	..	.....	..	.....	..	.....	2	1,250
41. Moving picture industry	2	200	..	.....	..	.....	1	175	..	.....	..	.....	3	375
42. Laundries	13	718	5	775	3	250	1	25	..	.....	5	440	27	2,208
43. Mattresses	1	188	..	.....	..	.....	..	.....	..	.....	1	125	2	313
44. Flour mills and grain elevators	2	85	..	.....	..	.....	1	65	..	.....	5	392	8	542
45. Garage	..	.....	..	.....	..	.....	..	.....	..	.....	..	.....	..	.....
46. Jewelry	15	1,401	1	535	..	.....	..	.....	..	.....	..	.....	16	1,936

to time, with results as noted. These data sheets are standard 8½x11 in. and fit in a vertical file where a folder for each prospect or non-customer is filed.

The census was extended to include all districts and was completed in 1913. Each representative is now required to keep an up-to-date census in his assigned territory and a complete report is required periodically by the general office. A census tabulation for the year 1926 is shown in an accompanying table. The classification of non-customers by industries includes power users not having central-station service exclusively. Many of these plants, however, have a partial or auxiliary service.

TABLE II—ANALYSIS OF ELECTRIC POWER CUSTOMERS (PAYING $250 AND OVER PER MONTH)—YEAR 1925. PUBLIC SERVICE ELECTRIC & GAS COMPANY, ELECTRIC DEPARTMENT

Classification of Business, Arranged According to Revenue	Total Number of Customers	Connected Load in Hp.	Total Kw.-Hr. for Year*	Total Average Monthly Demand in Kw.	Load Factor (8,760 Hours per Year Use of Connected Load) Per Cent	Load Factor (8,760 Hours per Year Using Average Monthly Demand in Kw.) Per Cent
1. Metal working	133	67,881	65,760,584	23,279	14.7	32.2
A. Automobiles	9	8,445	9,692,396	2,771	17.5	39.8
B. Foundries	20	11,383	11,506,827	3,974	15.7	33.2
C. General	11	6,737	7,391,143	2,312	16.7	36.5
D. General machine shop	38	13,182	9,315,267	4,276	10.8	24.9
E. Hardware and plumbing supplies	6	1,461	1,435,212	596	14.9	27.5
F. Junk yards	...	...	...	...	...	...
G. Novelties	2	293	320,050	107	16.7	34.2
H. Structural iron works	9	4,274	1,903,240	1,003	6.8	21.6
I. Sheet metal	24	9,685	8,566,393	3,361	13.5	29.1
J. Tools and cutlery	12	3,474	3,233,724	1,325	14.1	27.8
K. Steel making	2	8,947	12,396,332	3,554	21.1	37.4
2. Textile and dyeing	97	31,151	38,415,072	11,744	18.7	37.3
3. Rubber	33	33,323	40,063,162	12,263	18.4	37.3
4. Chemical works, dyestuffs, soaps	57	29,437	32,458,953	7,844	16.8	47.4
5. Wire works	17	28,262	38,888,505	11,477	21.0	38.7
6. Refrigeration, cold storage	45	17,090	36,588,174	6,137	32.5	68.2
7. Paper and paper products	17	11,352	26,305,437	5,228	35.2	57.6
8. Electric machine and supplies	17	16,766	22,492,044	6,370	20.4	40.3
9. Incandescent lamps	8	8,409	17,593,610	4,172	31.8	48.1
10. Water works and pumping	30	4,183	11,440,393	2,007	35.5	62.9
11. Utility corps. (for redistribution)	8	7,300	13,062,609	3,085	27.2	48.1
12. Shipbuilding and drydocks	11	27,220	8,702,638	3,684	4.9	27.0
13. Building contractors	10	7,921	10,223,516	2,453	19.6	47.6
14. Stone, concrete, sand, gravel, etc.	24	6,991	5,754,128	2,459	12.5	26.8
15. Paint, ink and varnish	24	6,895	6,570,268	2,367	14.5	31.7
16. Coke and byproducts	2	5,692	11,661,900	2,049	31.2	64.9
17. Railways and shipping	13	7,009	7,987,232	2,258	17.3	40.4
18. Clay working	23	6,683	5,865,279	2,205	13.4	30.3
19. Foodstuffs (not baking)	21	6,916	6,183,164	2,214	13.6	32.0
20. Smelting and refining	11	5,645	8,577,330	1,759	20.5	55.7
21. Leather manufacturing	17	8,043	6,223,409	2,258	11.8	31.4
22. Oxygen and byproducts	7	3,213	9,339,550	1,475	44.6	72.1
23. Oil and oil products	11	4,285	7,429,855	1,298	26.4	65.4
24. Oil cloth and linoleum	4	6,332	7,222,660	2,003	17.4	41.2
25. Cork	5	5,562	6,146,720	1,574	16.8	44.6
26. Telephone exchange, radio, etc.	11	4,831	5,163,683	1,619	16.3	36.4
27. Clothing and allied industries	18	4,193	4,088,603	1,424	14.8	32.8
28. Woodworking	14	5,894	3,791,944	1,855	9.7	23.3
29. Packing houses	8	2,939	5,665,545	1,128	29.4	57.3
30. Baking	12	2,314	3,043,690	987	20.1	35.2
31. Printing	12	3,130	2,604,941	1,279	12.5	23.2
32. Dairy products	9	1,779	2,716,599	605	23.2	51.1
33. Flour mills	4	4,160	2,183,220	705	7.9	35.2
34. Office buildings	7	2,138	1,418,237	551	10.1	29.4
35. Stores	2	941	1,321,418	436	21.2	34.7
36. Novelties	7	1,562	1,076,021	527	10.5	23.3
37. Celluloid and celluloid products	2	2,294	1,717,860	463	11.4	42.4
38. Hotels	6	954	1,224,630	305	19.6	45.7
39. Buttons	5	994	1,143,849	356	17.5	36.7
40. Tobacco	3	927	1,305,100	448	21.4	33.2
41. Miscellaneous buildings	3	835	979,320	389	17.8	28.7
42. Loft buildings	4	623	713,000	267	17.4	30.4
43. Laundries	5	773	660,600	250	13.0	30.1
44. Leather goods	5	973	562,226	300	8.7	21.3
45. Enameling	2	412	739,160	182	27.4	46.4
46. Asbestos goods	1	600	643,800	221	16.1	33.1
47. Coal and ore handling	1	344	667,280	131	28.9	58.2
48. Mattresses	1	413	397,960	104	14.6	43.6
49. Brushes	2	430	295,600	158	10.4	21.3
50. Municipal buildings	2	557	193,183	207	5.2	10.6
51. Moving picture industry	1	704	285,520	90	6.2	36.2
52. Garages	1	578	158,017	107	4.2	16.9
53. Beverages	1	163	142,460	73	13.3	22.3
54. Confectionery	1	115	136,773	39	18.1	40.0
55. Jewelry, silverware	1	161	92,500	60	8.8	17.6
Total	796	410,292	496,088,931	138,928	Avg. 18.4	Avg. 40.7

*Based on all customers operating full twelve months during the year, except refrigeration. Compiled Oct. 1, 1926.

Sales Methods

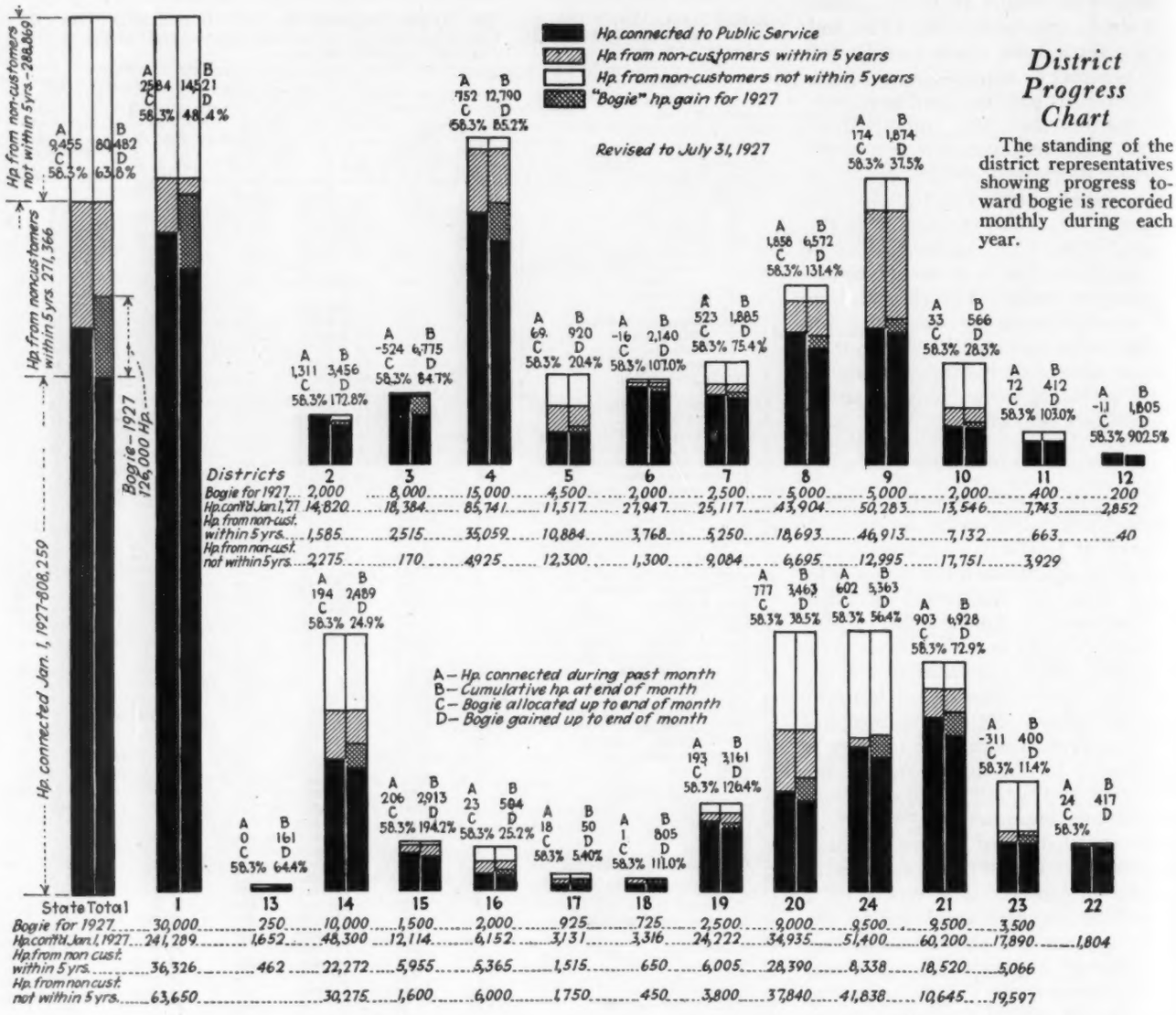
The sales methods involve engineering and salesmanship in varying degrees of mixture. An analysis of operating conditions must be made in every case, and the points favoring the purchase of power brought out. Advantages may be either physical or financial; usually both elements are present. Capital investment is probably the greatest factor favoring purchased power, if additional capacity is required. Saving in labor and increase in production are also factors of extreme importance.

Recent analysis of a plant indicated no advantage in cost of operation with purchased power. The report by a consulting engineer employed by the manufacturer also showed no saving. The change to purchased power was made, however, due to good salesmanship on the part of the power representative in convincing the customer of some intangible advantage. A follow-up by the representative after five months' operation indicated that the customer was well pleased. He not only had made a saving in operating expense but had also increased production by 10 per cent.

During the last fifteen years the manufacturer has learned much regarding the cost of power. His cost accounting is better and therefore operating tests need not be so frequently made. Analyses of costs are still necessary, however, and sales opportunities develop from time to time due to changes in operating or production methods.

The census data and cost reports are the basis of the representatives' sales efforts. General supervision of their work insures constant, intimate knowledge of the power problems of individual power prospects. By using an industrial analysis of power customers similar to that shown in the table, the representative is able to estimate the probable load factor and income from prospective new business. With such data available he can concentrate on the most profitable prospects.

Each month the representative reports the result of his efforts to the agent of his district. These reports are tabulated each month so that a bird's-eye view of results obtained can be given to the supervisors. A tabulation for the first six months of 1927 is shown. The men are not judged entirely by this record, as varying conditions may contribute to, or hinder, the success of the salesman in obtaining new power business. The records, however, are useful in analyzing the growth of the power business. In 1926 the gain in connected load was 127,800 hp. in industrial power. Of this gain, 27 per cent represented former users of private power plants, 32 per cent represented increase in power requirements of customers and 41 per cent comprised new industries in the territory. During the same year 9,000 kva. of new private plant equipment was installed. The central station, therefore, secured approximately 91 per cent of all the new power installed. Most of the new private plant apparatus was for use in industries requiring large quantities of steam in process.


Hp. connected to Public Service
Hp. from non-customers within 5 years
Hp. from non-customers not within 5 years
"Bogie" hp. gain for 1927
Revised to July 31, 1927
A—Hp. connected during past month
B—Cumulative hp. at end of month
C—Bogie allocated up to end of month
D—Bogie gained up to end of month
Districts
Bogie for 1927
Hp. contd. Jan. 1, 27
Hp. from non-cust. within 5 yrs.
Hp. from non-cust. not within 5 yrs.
State Total
Hp. connected Jan. 1, 1927-808,259
Hp. from non-customers within 5 yrs. 271,366
Hp. from non-customers not within 5 yrs.-288,869
Bogie-1927 126,000 Hp.

District Progress Chart

The standing of the district representatives showing progress toward bogie is recorded monthly during each year.

Districts	State Total	1	13	14	15	16	17	18	19	20	24	21	23	22	2	3	4	5	6	7	8	9	10	11	12
Bogie for 1927	30,000	250	10,000	1,500	2,000	925	725	2,500	9,000	9,500	9,500	3,500		2,000	8,000	15,000	4,500	2,000	2,500	5,000	5,000	2,000	400	200	
Hp. contd. Jan. 1, 1927	241,289	1,652	48,300	12,114	6,152	3,131	3,316	24,222	34,935	51,400	60,200	17,890	1,804	14,820	18,384	85,741	11,517	27,947	25,117	43,904	50,283	13,546	7,743	2,852	
Hp. from non-cust. within 5 yrs.	36,326	462	22,272	5,955	5,365	1,515	650	6,005	28,390	8,338	18,520	5,066		1,585	2,515	35,059	10,884	3,768	5,250	18,693	46,913	7,132	663	40	
Hp. from non-cust. not within 5 yrs.	63,650		30,275	1,600	6,000	1,750	450	3,800	37,840	41,838	10,645	19,597		2,275	170	4,925	12,300	1,300	9,084	6,695	12,995	17,751	3,929		

Each year a bogie is set for each district. This bogie is made up in conference with the representatives, so that the goal is really set by the representatives themselves. A chart is prepared and progress each month indicated. The solid portion of each pilaster represents the total connected load in a district. The hatched portion represents the existing additional business obtainable in connected horsepower. The double-hatched portion is the bogie for the year. The open or upper portion of the pilaster is power now used in industries which, because of special conditions, may not be prospective business for several years to come. This chart is corrected

TABLE III.—MONTHLY REPORT OF POWER REPRESENTATIVES COVERING ADDITIONAL CONNECTED LOAD SIGNED DURING 1927
PUBLIC SERVICE ELECTRIC & GAS COMPANY

Power Representatives	January		February		March		April		May		June		To June 30 Cumulative	
	Hp. Signed	Annual Revenue	Hp. Signed	Annual Revenue	Hp. Signed	Annual Revenue	Hp. Signed	Annual Revenue	Hp. Signed	Annual Revenue	Hp. Signed	Annual Revenue	Hp. Signed	Annual Revenue
1	2,578	$57,900	2,058	$42,300	1,275	$27,600	750	$12,000	.....	.....	1,160	$28,900	7,848	$168,700
2	770	18,550	665	12,000	743	9,700	2,189	31,000	446	$7,500	334	6,200	5,147	84,950
3	613	8,376	708	16,610	666	15,705	891	15,150	512	10,400	778	16,200	4,168	82,441
4	.....	.....	.....	.....	.....	.....	193	3,840	210	3,500	85	700	488	8,040
5	685	13,000	1,020	31,584	1,275	31,530	57	850	390	7,400	861	16,960	4,288	101,320
6	773	10,490	267	5,790	3,549	109,877	662	5,975	77	636	1,890	6,750	7,218	139,518
7	456	6,550	423	7,500	497	14,475	318	6,000	110	1,800	157	1,600	1,961	37,925
8	656	17,276	1,085	8,772	368	4,275	312	5,600	277	6,000	315	6,500	3,013	48,423
9	501	10,800	349	6,980	285	5,700	508	10,160	300	5,082	446	10,920	2,389	49,642
10	.....	.....	.....	.....	.....	.....	.....	.....	17	360	435	7,300	452	7,660
11	978	29,670	735	23,596	740	26,211	1,274	63,876	994	37,751	572	11,453	5,293	192,557
12	497	23,544	352	16,912	533	12,248	301	11,726	313	14,408	385	18,360	2,381	97,198
13	700	7,251	2,496	62,378	1,167	29,175	2,424	37,049	918	21,975	573	19,512	8,278	177,340
14	700	7,251	2,496	62,378	1,167	29,175	2,424	37,049	918	21,975	573	19,513	8,278	177,340
15	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
16	2,721	40,843	976	24,400	138	3,450	760	19,120	315	1,950	266	6,625	5,176	96,388
17	1,099	44,306	202	6,866	406	6,739	526	18,258	278	9,008	269	6,600	2,780	91,777
18	213	6,290	593	8,300	403	8,325	274	10,150	146	3,100	269	6,600	1,898	42,765
19	250	3,500	400	4,000	375	7,700	900	36,000	900	36,000	674	7,300	3,499	94,500
20	135	1,510	260	3,350	75	900	90	100	375	3,800	145	2,340	1,080	12,000
Total.....	14,016	$305,597	14,834	$340,366	13,587	$341,885	14,853	$323,903	7,496	$192,645	10,287	$200,333	75,635	$1,710,485

TABLE IV.—POWER CENSUS OF NON-CUSTOMERS DEC. 31, 1926, AS PER POWER CENSUS DATA.
PUBLIC SERVICE ELECTRIC & GAS COMPANY

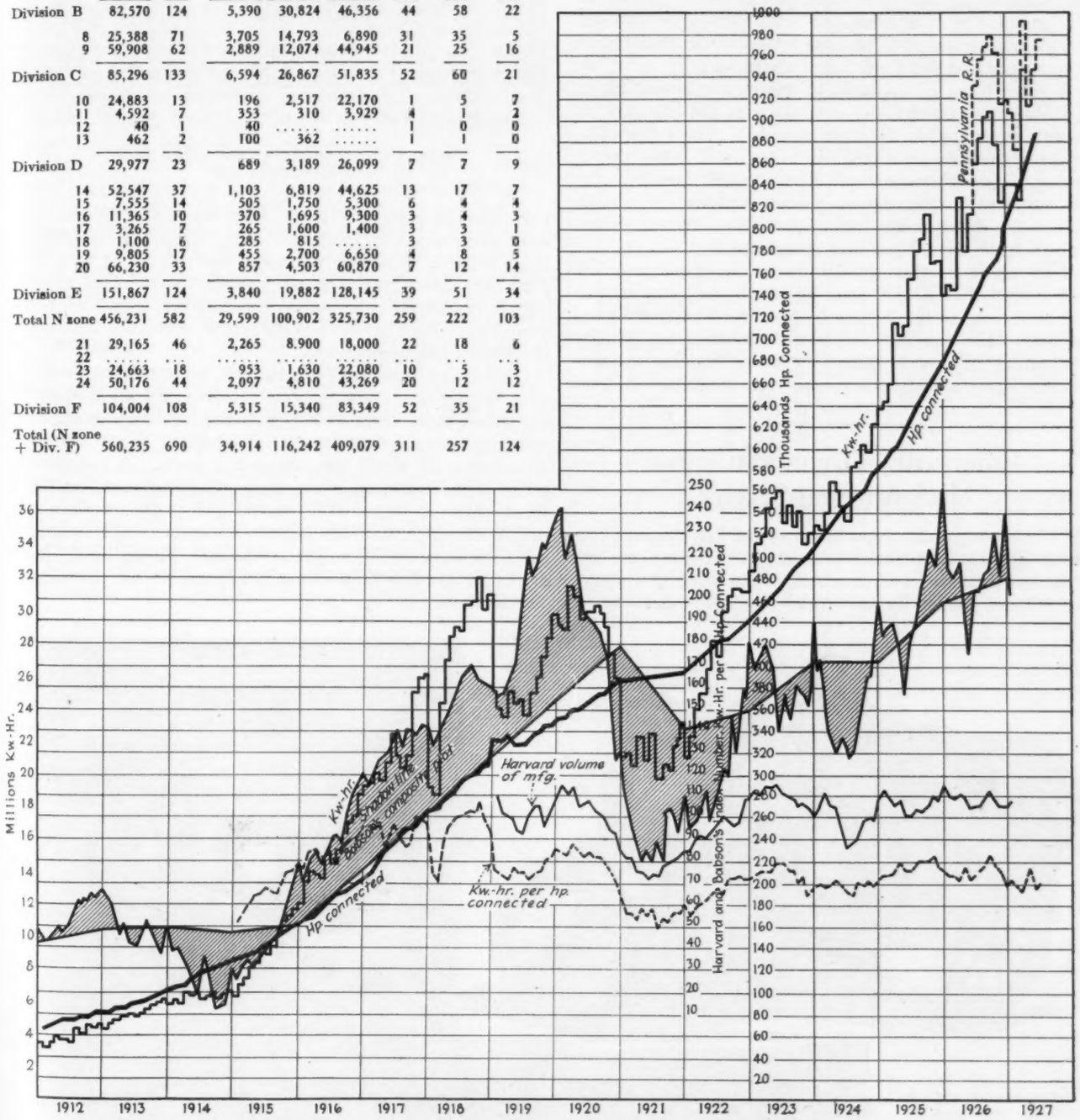
No. 1, Red = 50 to 200 hp.; No. 2, Blue = 201 to 1,000 hp.; No. 3, Green = 1,001 hp. and over.

District	Hp. of Total Plants	Total Number of Plants	Hp. of Plants No. 1, Red	Hp. of Plants No. 2, Blue	Hp. of Plants No. 3, Green	Number of Plants No. 1, Red	Number of Plants No. 2, Blue	Number of Plants No. 3, Green
1	99,976	160	11,666	18,215	70,095	105	40	15
2	3,860	10	460	1,400	2,000	5	4	1
3	2,685	8	960	525	1,200	6	1	1
Division A	106,521	178	13,086	20,140	73,295	116	45	17
4	39,984	63	2,723	19,255	18,006	20	34	9
5	23,184	20	834	2,250	20,100	7	6	7
6	5,068	14	863	2,400	1,805	8	4	2
7	14,334	27	970	6,919	6,445	9	14	4
Division B	82,570	124	5,390	30,824	46,356	44	58	22
8	25,388	71	3,705	14,793	6,890	31	35	5
9	59,908	62	2,889	12,074	44,945	21	25	16
Division C	85,296	133	6,594	26,867	51,835	52	60	21
10	24,883	13	196	2,517	22,170	1	5	7
11	4,592	7	353	310	3,929	4	1	2
12	40	1	40	.....	.....	1	0	0
13	462	2	100	362	.....	1	1	0
Division D	29,977	23	689	3,189	26,099	7	7	9
14	52,547	37	1,103	6,819	44,625	13	17	7
15	7,555	14	505	1,750	5,300	6	4	4
16	11,365	10	370	1,695	9,300	3	4	3
17	3,265	7	265	1,600	1,400	3	3	1
18	1,100	6	285	815	.....	3	3	0
19	9,805	17	455	2,700	6,650	4	8	5
20	66,230	33	857	4,503	60,870	7	12	14
Division E	151,867	124	3,840	19,882	128,145	39	51	34
Total N zone	456,231	582	29,599	100,902	325,730	259	222	103
21	29,165	46	2,265	8.900	18,000	22	18	6
22	.....	...	.....	.....	.....	...	...	...
23	24,663	18	953	1,630	22,080	10	5	3
24	50,176	44	2,097	4,810	43,269	20	12	12
Division F	104,004	108	5,315	15,340	83,349	52	35	21
Total (N zone + Div. F)	560,235	690	34,914	116,242	409,079	311	257	124

each month and photostats are sent to district agents and other executives.

Another monthly progress chart is sent to each division agent and other executives interested, showing the gain in industrial load in terms of per cent of "bogie." The chart indicates that up to July 31, 1927, all but one of the divisions is ahead of bogie. The total gain was 81,000 hp., or 64 per cent of the annual bogie. The bogie called for 58 per cent, including July. The net gain in connected load is used in making up the progress charts. The actual new business secured may be in excess of the net gain, inasmuch as cut-offs have been deducted.

A historical record of industrial power in Public



Public Service Progress as Related to Economic Indices

This offers a record of progress for the whole power load of the electric company. Sales in millions of kilowatt-hours is shown from the inauguration of the power sales organization to the present time. Connected horsepower is also indicated. The Babson chart has been superimposed on the drawing, and, with the index of the Harvard Economic Service Volume of Manufacturing, shows the trend of national economic conditions. The line plotting kilowatt-hours per horsepower connected shows the sequences of industrial activity in Public Service territory and follows closely the indicated national trend.

Service territory since 1912 has been plotted. Kilowatt-hours and connected load are shown by months. The kilowatt-hours per connected horsepower are also recorded by months. The "Compositplot" of Roger Babson and the curve of "Volume of Manufacturing" of the Harvard Economic Service are superimposed. This chart has been in use by the Public Service power sales department since 1920. The relation between power sales in kilowatt-hours and business conditions in this country is very evident. In fact, the sale of energy to the diversified industries in New Jersey is a direct indication of business conditions in the United States.

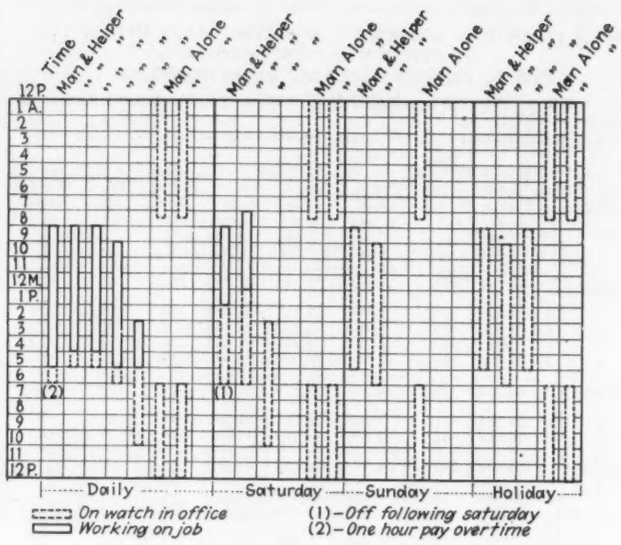
Since no special rate adjustment for power factor is embodied in the rate schedules, power factor correction in customers' installations has been carried on through moral suasion by co-operation between the distribution department and the power representatives.

A description of methods of measuring power factor in Public Service territory was given in the ELECTRICAL WORLD of Aug. 13, 1927 (page 301). The representatives use the data from such tests to "sell" better power factor to power customers. Blank power factor charts are supplied to the power representatives for use in graphically determining the amount of correction necessary to reach the 80 per cent specified.

The report of the general power representative for 1926 states that 33,000 kva. of synchronous apparatus was connected to the system by power customers during the year. The customer, especially the large one, usually co-operates in power factor correction when the facts are intelligently and comprehensively presented to him.

Emergency Organization for Underground Service

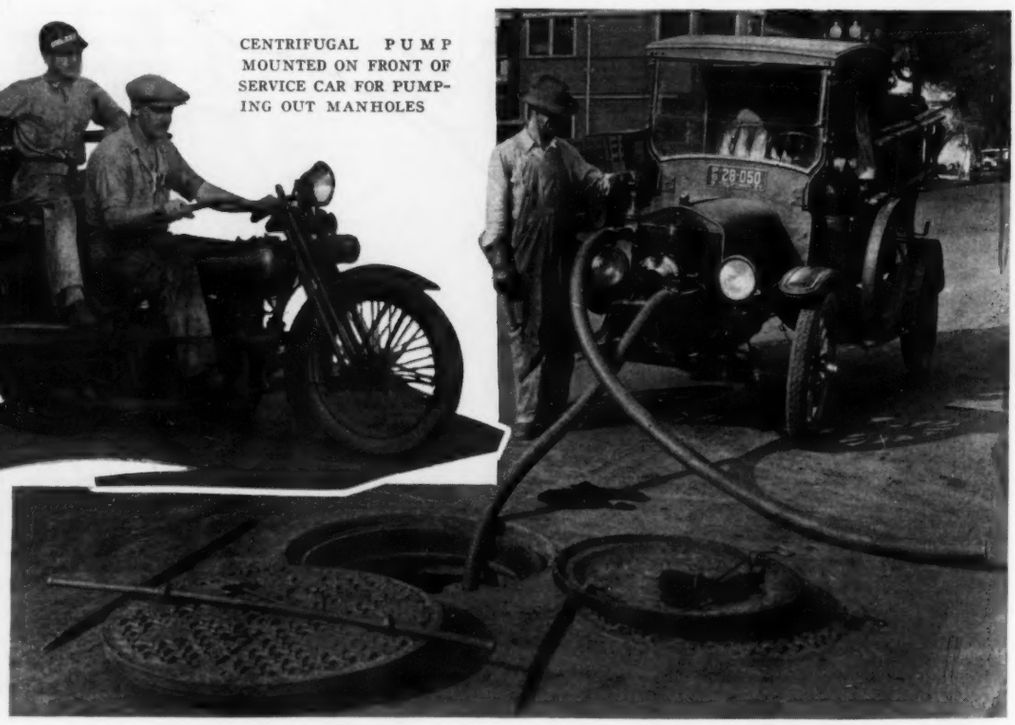
THE underground department of the Los Angeles Gas & Electric Corporation is so organized that there are never less than two men on watch in the office on a weekday subject to service or emergency call. Between 5 p.m. and 10 p.m., the hours between which trouble is most likely to occur, three men are on duty, one of whom has a helper. Working hours and the number of men on duty are shown in the accompanying chart. This gives the daily, Saturday, Sunday and holiday schedules for insuring prompt action in connection with calls for underground emergency work.



WORKING SCHEDULE OF UNDERGROUND SERVICE AND EMERGENCY MEN

Ordinary trouble calls are handled by one or two men, who use the type of motorcycle shown in the accompanying photograph. Similar equipment is used also by cable-splicing crews. One specially equipped Ford car is available at all times for emergency work. A complete set of tools is carried in the body of the car, and on the front there is mounted a centrifugal pump as shown, driven directly from the engine crankshaft. The pump has a capacity of 9,000 gal. per minute through a 2½-in. discharge and has been found indispensable for pumping out manholes.

MOTORCYCLE CART USED BY UNDERGROUND SERVICE MEN AND CABLE SPLICERS



CENTRIFUGAL PUMP MOUNTED ON FRONT OF SERVICE CAR FOR PUMPING OUT MANHOLES

First 154-Kv. Line Installed in Alabama

Gorgas-Wilson dam 110-kv. line reinsulated for 154 kv. New line from Martin dam to Leeds under construction to augment supply to Birmingham district

ON SEPT. 18 the reinsulated Gorgas-Wilson Dam line of the Alabama Power Company was cut into service, this being the first step in the addition of 154-kv. lines to the Alabama system. This line was originally constructed during the World War to transmit power from the Gorgas steam plant to the government nitrate plants at Muscle Shoals. Upon the completion of Wilson dam, this line, together with the Wilson dam-Huntsville-Gadsden and other lines, has been used to distribute Muscle Shoals power throughout the various companies located in the Southeastern states.

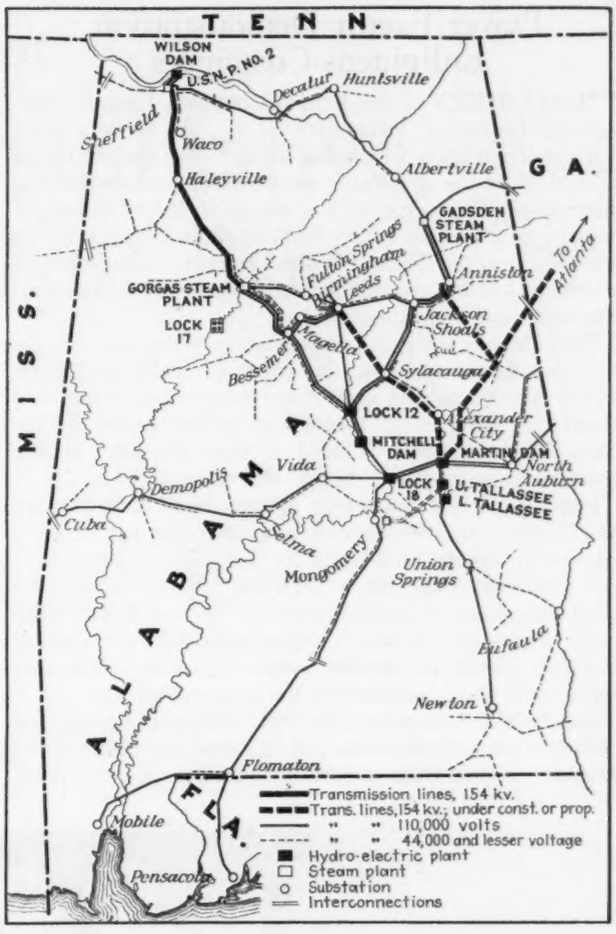
The Gorgas-Wilson dam line was originally built for 154 kv. but insulated for 110 kv., wood-pole H-frame construction being used. The reinsulation consists of eleven units in suspension and twelve units with double yoke in strain. The old line was equipped with arcing horns, which were not changed in the cut-over. At the Gorgas steam plant a 60,000-kva., 154/110-kv. auto-transformer bank has been installed. Switching at Wilson dam is done with 154-kv. oil switches, whereas at Gorgas this is done on the 110-kv. side. In its 154-kv. program the Alabama Power Company intends to do all switching on the low-tension side, keeping the transformers and the line as a unit.

Changes Entailed by Raising Voltage from 110 to 154 Kv.

The change-over on this line from 110 kv. required a new 15,000-kva. bank of transformers at Haleyville. At Waco the 110-kv. primary substation was abandoned and power was supplied by a new 44-kv. line from Sheffield.

With the completion of the Upper Tallassee hydro plant in June, 1928, Lock 18 in January, 1929, and ultimately Lower Tallassee (about 1932), the company will be compelled to have additional line capacity to take power into the Birmingham and Anniston districts. Assurance of the highest possible service conditions to these districts requires that sufficient line capacity be available. To accomplish this, construction was started last summer on a new line that will run from Martin dam to Leeds by way of Alexander City, a distance of 77 miles. This line will be of special cross-braced H-frame steel construction with towers 60 ft. above ground line and 39-ft. crossarms mounted 56 ft. above the ground.

These crossarms will allow a conductor spacing of 19 ft. 6 in. Conductors will be 397,500-circ.mil A.C.S.R., with two No. 2/0 composite aluminum-steel ground wires, flexibly attached to the towers. Insulations will be for 154 kv. and will consist of eleven units in suspension and twelve units double yoke on strain with grading shields used throughout the line. Until the time the Lower Tallassee plant is brought into operation this line will operate at 110 kv., the line being connected without transformers to the 110-kv. bus at each end. When changed to 154-kv., 110/154-kv. auto-transformers having a rating of from 75,000 kva. to 90,000 kva. will be installed, with switching being done on the low-tension side.



TRANSMISSION SYSTEM OF ALABAMA POWER COMPANY, SHOWING ADDITION OF 154-KV. LINES

The only primary substation on this line will be at Alexander City, which is now served by a 44-kv. line that goes through this city from North Auburn to Sylacauga. The new substation to be constructed will better service conditions to the textile industries located here and also allow for future expansion.

Plans are also being considered for a 154-kv. line from Martin dam to the Georgia Power Company with a branch to Anniston. In construction details this line will be identical with the Martin dam-Leeds line.

Serving Large Power Blocks

COMMENT upon the value of special disconnecting facilities in the shape of a newly developed industrial-type pothead was contained in the article by Wellen H. Colburn, of the electrical engineering staff of the Boston Edison Company, upon the new 24-kv. system of that organization (ELECTRICAL WORLD, Oct. 22, 1927, page 847). This was followed by numbered paragraphs explaining what the arrangement recommended provides. Paragraph 6 should have been printed as below:

"6. Opportunity to apply a high-potential or other test to the transformer windings, should advance in the art or the company's testing program make it advisable."

The article referred to a method of avoiding overhead braces and structures for outdoor transformers.

Power Factor Demonstration Enlightens Customers

CUSTOMERS of the British Columbia Electric Railway Company, Vancouver, B. C., are given a practical demonstration of power factor and power factor correction by the apparatus shown in the accompanying illustration. The apparatus is set up in the basement of the company's main office building and consists of an induction motor, Fynn-Weichsel motor, direct-current generator, loading resistance, static condenser and control apparatus and instruments.

With this set-up it is possible to vary the load on the induction motor to show the effect of underloading on power factor and the corrective value of a static condenser. A mechanical foot brake on the pulley of the Fynn-Weichsel motor is used to vary the load on the motor to show its power factor characteristics.

The cost of the apparatus amounted to a little more than $3,000, and although the company has not actually received in dollars and cents its full value, nevertheless on numerous occasions a practical demonstration has aided materially in getting over the power factor story to the customer. After a demonstration the customer generally is able to see the value of power factor correction both to himself and to the power company.

The British Columbia Electric Railway Company has a power factor clause in its power rates that requires the customer to maintain a certain specified power factor, otherwise his bill is augmented by the formula: (*Rate* × *power factor required*) ÷ *Power factor obtained.*

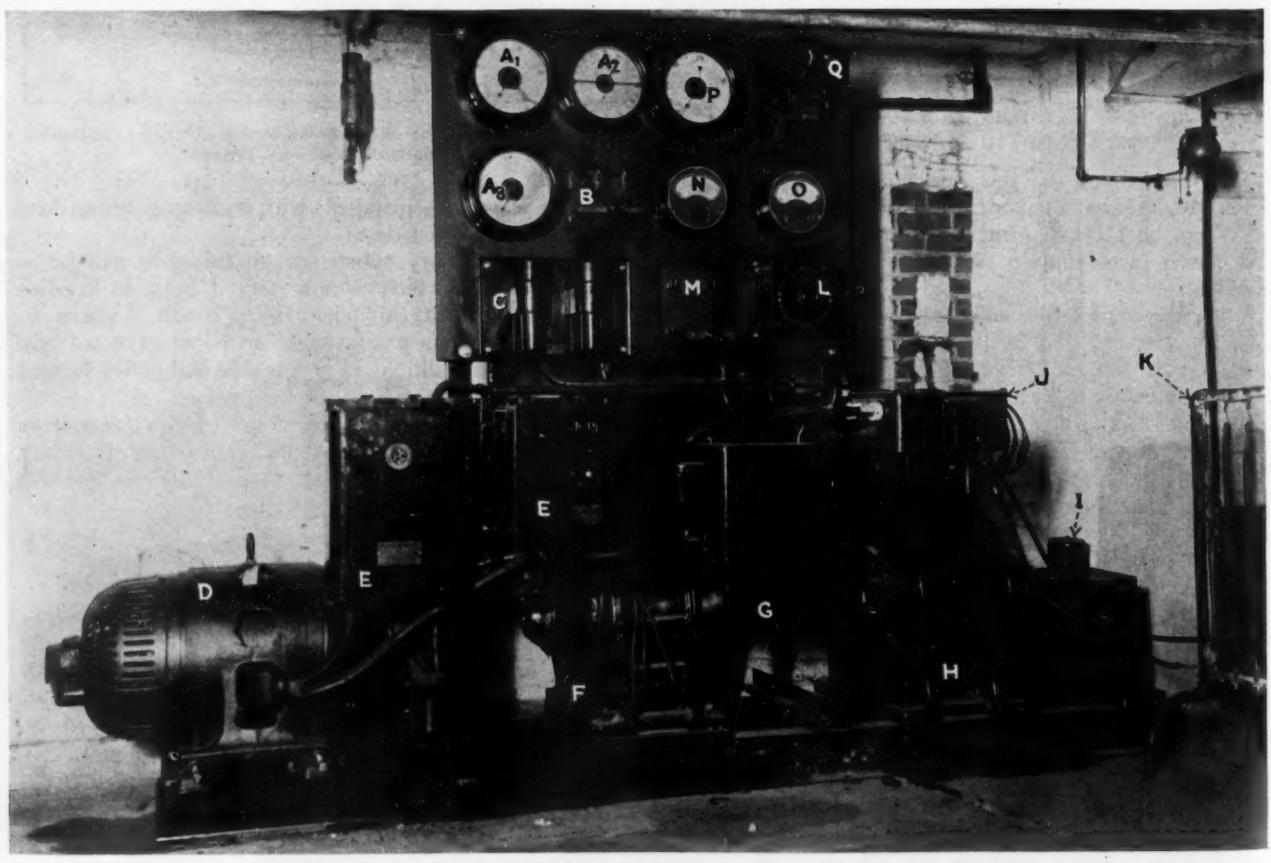
The company's policy with reference to power factor correction and the methods being employed to raise the system power factor are discussed in an article entitled "Savings From Power Factor Correction," on page 61 of the July 10, 1926, issue of ELECTRICAL WORLD.

Street-Lighting Construction Costs

THE accompanying tabulation shows the unit and extended prices covering the installation, less lamps, of the new street-lighting system at Bellwood, Ill., a village of about 5,000 population. The installation includes 504 single posts with ball globes and uses 2,500- and some 4,000-lumen lamps.

COST OF ORNAMENTAL STREET LIGHTING AT BELLWOOD, ILL.

	Unit Price	Extension
119,670 ft. trenching 4x12 in.	$0.06	$7,180
8,130 ft. 2½-in. pipe under street	1.50	12,195
800 ft. 2½-in. pipe under railroad	2.00	1,600
Seven manholes	366.00	2,562
29,000 ft. No. 8 cable, 5,000 volt	0.37	10,730
173,460 ft. No. 8 cable, 600 volt	0.25	43,365
24 4.2-kva. transformers	196.00	4,704
Four regulators	1,050.00	4,200
Two three-pole time switches	165.00	330
504 concrete foundations	5.00	2,520
504 concrete standards	53.00	26,712
4 wooden poles	110.00	440
Total		$116,538



APPARATUS USED TO CLARIFY THE POWER FACTOR PROBLEM IN CUSTOMERS' MINDS

A_1—A.c. ammeter on incoming line
A_2—Power factor meter
A_3—A.c. wattmeter
B—Switch for static condenser
C—A.c. overload relays
D—15-hp., 220-volt, three-phase, 1,200-r.p.m. Fynn-Weichsel motor
E—Starting equipment for motor D
F—20-hp., 220-volt, three-phase motor
G—Compensator for motor F
H—20-hp., 125-volt, d.c. generator
I—5-kva., 220-volt, three-phase static condenser
J—Main oil switch
K—Resistance load for d.c. generator
L—Generator field rheostat
M—Main switch for generator
N—D.c. ammeter
O—D.c. voltmeter
P—A.c. voltmeter
Q—Circuit breaker for d.c. generator

Purchasing Methods That

Encourage Initiative, Not Price Wars

By L. B. BONNETT
Purchasing Agent Brooklyn Edison Company

Buying power plant equipment in such a way as to encourage the manufacturers to offer the best apparatus which they know how to build was the basis of purchasing methods outlined by Mr. Bonnett in his address before the Metropolitan Section of the American Society of Mechanical Engineers lately. Specifications are so written as to give the manufacturer a wide latitude, price competition is removed, and it is clearly indicated that excellence of performance has a definite and recognized value to the buyer. It is pointed out that the selection of material must be a matter of judgment, and despite the predisposition of the buyer to like equipment which has given favorable performance, he must properly weigh the improvements that others are making and invite the freest and most wide-open competition.

IN EXTENDING power plants and building new ones, engineers strive to obtain the best possible results, taking into account both first cost and operating costs. After the general plan of design has been decided upon, perhaps the most important factor in its bearing on final results is the selection, among different makes, of the individual pieces of equipment that together make up the power plant. It is the belief in our company that prudent selection can best be reached when there is the freest and most wide-open competition among manufacturers. Where purchasing and engineering functions are separated, as they now are in most large companies, satisfactory results of such a policy are possible only through complete co-operation and mutual confidence and understanding between the purchasing and the engineering departments.

Our process of purchasing competitively interweaves through the two departments and may perhaps be divided into four parts:

1. The specifications prepared by the engineers.
2. The obtaining of proposals under these specifications by the purchasing department.
3. The evaluation of these proposals through the co-operation of both departments.
4. The final closing of the purchase.

The specification is intended primarily to describe the operating results to be obtained, leaving just as wide open as possible to the judgment of the bidder the detailed methods by which this result is accomplished. This specification must, of course, define the limiting conditions, such as available space, maximum size and weight of parts, temperatures which can be handled, pressures, etc. Perhaps what is meant can best be illustrated by comments on the specification on which our last condenser was purchased. The first sentence of this is as follows: "It is the intent and purpose of this specification that the manufacturer shall furnish, deliver, erect and place in operating condition satisfactory to the company one surface condenser with auxiliaries and miscellaneous equipment as specified herein, for use with a 110,000-kw. turbine in the Hudson Avenue station of the company." Information was included on the available space between foundation columns; the temperature of the circulating water, minimum, maximum and average; the pumping head required, and the weight which may be carried on the turbine exhaust nozzle. A size of tubes was mentioned, but the bidders were invited to present alternatives if they so desired, and as a matter of fact the condenser was purchased with a different size tube than that first specified.

One perhaps unusual feature was the complete omission of any requirement of the square feet of surface or of any limitation on the number of passes. Instead information was included from which the manufacturer could himself determine the best size and arrangement for his particular design. The turbine water rates with vacuum corrections were given, together with the value to the company of decreased coal consumption due to improved vacuum. The cost of pumping water was indicated so that the manufacturer could choose the proper balance between surface and water volume. The method of calculation from these data with an example was given to indicate just how we propose to make comparisons of performance. With this as a basis, the manufacturer, knowing his costs of two different sizes of condensers with tubes, could work out for each size the fixed charges and the operating charges and so arrive at the most economical proposition for him to put in. Such a specification, we believe, allows the widest latitude to all manufacturers to present the propositions which best fit their

particular methods of manufacture and design, hence gives us the broadest view of possible variations from which to choose.

These specifications are then submitted by the purchasing department to the manufacturers for proposals, with the request that these proposals be separated into two parts: first, the complete engineering proposal, including all performance guarantees as required by the specification, dimensions and descriptive material necessary for us to form judgment as to the adequacy of the proposal; and a second part covering price and shipment on the material described in the first half of the proposal. While the proposals are being worked up, every possible opportunity is afforded the manufacturers for discussion with the company engineers so that our requirements may be clearly understood and the advantages of each manufacturer's design may be fully presented. When formal proposals come in, the engineering part is sent to the engineering department for study and evaluation in comparison with similar proposals from other manufacturers.

Selection a Matter of Judgment

It must be recognized that the selection of material to be purchased must be a matter of judgment and cannot be a matter of rigorous mathematical solution. However, the better informed the judgment and the more clearly seen the relative importance of different factors which go to make up one's preference, the more nearly correct the final judgment will be and the more nearly certain it is that the operating results will be the best possible under the conditions. We are all more or less predisposed to like certain kinds of equipment, because we have had favorable experience with them, but such experience must not be allowed to blind us so that we fail properly to weigh improvements that others are making.

It has been our experience that if we form first our judgment of the relative advantages of different propositions from the engineering data only, without the price, we can with more freedom from prejudice weigh the advantages and disadvantages other than those expressed in actual performance guarantees. The process of asking oneself how much more in dollars one proposition is worth than another is conducive to careful thought to make certain that one's opinions have a sound basis of fact. We believe it to be sound policy in comparing propositions to take the performance guarantees of reputable manufacturers at their face value without any corrections for probable or possible differing margins of safety which may be claimed. If a manufacturer desires to make a certain guarantee and then asserts that he has an extra large factor of safety, we are compelled to believe either that the factor of safety is mostly in the salesman's talk or that the company submitting the proposal has not the courage of its convictions. We expect to test, after installation, all equipment to see that it meets the performance guarantees, and so we expect the manufacturer to retain sufficient margin to cover the contingencies of manufacture which his experience has indicated necessary. We expect that the material when installed shall either meet guarantees or be corrected by the manufacturer until it does come up to guaranteed performance. Occasionally guarantees come in that are so far out of line with usual performance, sometimes better, sometimes worse, that apparently some error in calculation has been made. Such apparent errors or inconsistencies are, of course, called to the manufacturer's attention for correction or justification.

The basis of the mathematical evaluation of the performance guarantees is an estimated load duration curve of the main unit, this curve being the amount of load plotted against hours of use. At best this load curve is only a crude approximation of what the machine will actually carry, since many of the factors which have a bearing on the hour's use of any machine are entirely indeterminate. For instance, what radical improvements may be developed and incorporated in the next unit, because of which the present unit becomes less useful for base load operation? What troubles may occur or what rearrangements of the station may be necessary, seriously affecting the division of load between units or between stations? However, despite the admitted inaccuracy of such a predicted load curve, if thoughfully prepared, it unquestionably is more accurate than just an off-hand guess as to the average load and useful life of the machine.

Again, because of the inexactness of the premise, extreme accuracy in arriving at the annual and capitalized operating costs is unnecessary. It frequently happens that the obviously most efficient or most suitable machine is also the lowest in first cost, and after a preliminary inspection of the proposals a conference between the engineering and the purchasing departments will settle the choice without question. In other cases where there are several bids, such a conference may show that some of the bids are obviously out of the running because of comparatively poor performance, often coupled, strangely enough, with high price. With these eliminated, the remaining proposals become a subject of mathematical study of operating costs. The results of such analysis indicate the capitalized advantage of one proposition over another due to better performance.

Only Intangibles Justify Rough Estimates

There often are factors on which only rough estimates can be made; for instance, one equipment may occupy much more space than another and because of that cause changes in construction of other parts of the job which will increase cost or decrease convenience. The dollar value of this must be estimated. Duplicate equipment may reduce the value of spare parts necessarily held in stock. Such items are reasonably tangible. Unsatisfactory performance in the past would be, of course, a sound reason for rejection of a proposal unless evidence is presented that the difficulties have been overcome. Any such reason for the elimination or serious handicapping of any proposition must be convincing that it is based on fact and has been given no more weight than it deserves; otherwise this would be the means of completely destroying any open-minded consideration of improvements that are continually being made. There are often minor factors of preference against which it would be almost impossible to assess a definite value, but an expression can quite properly be made of an unevaluated preference, other things being equal. This would have a very important bearing on the placing of the business if the prices as weighted by the evaluation factors are very close together.

When the performance calculations have been completed, the results are gone over in a conference among those responsible for operation, engineering, and purchasing, and final figures are agreed upon showing the comparative value to the company of the different propositions under consideration. They are conveniently expressed as excess charges against certain proposals. The purchasing department then takes the quoted prices

and adding the evaluation charges arrives at weighted figures of cost. Considering also matters of purchasing policy, such as the dependability of promises of shipment, the time required for manufacture, the reputation of the manufacturer for fairness in taking care of minor changes and the encouragement of active competition, the proper disposition of the order becomes at once apparent.

We feel that this procedure has the very definite effect of encouraging the manufacturers to propose the best equipment which they know how to build. It clearly indicates that excellence of performance has a definite and recognized value to us. It stimulates the proposing of improved designs as soon as they are available. We believe it results in the fairest judgment of the merits of different proposals and therefore results in the purchase of the most satisfactory equipment for the physical conditions which have to be met.

Automatic Control for Rural Mine Hoist

By S. E. Wright
Power Engineer Ohio Public Service Company, Massillon, Ohio

ARRANGEMENT OF BUILDINGS AT THE RURAL MINE

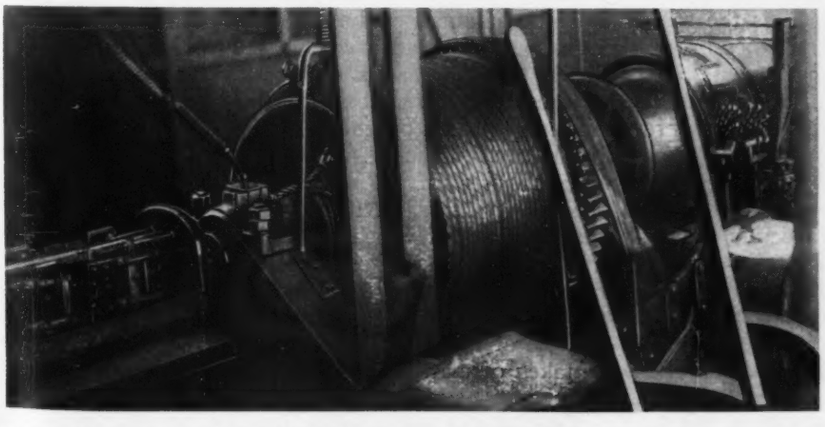
TWO YEARS ago the Ohio Public Service Company started negotiations with the Heimann Coal Company of Massillon, Ohio, for the electrification of its rural mine. Because the mine had but two more years to run it was thought at first that electrification could not be made to pay in the time allotted for operation. However, data were obtained and eqiupment determined.

It was found that a 32.8-hp. double squirrel-cage induction motor would be suitable for hoisting work; a 20-hp. motor would do pumping and a 1-hp. motor could be used on the gathering pump. A 5-hp. motor was adequate for the ventilating fan.

All of this equipment was made automatic. Whereas it was a very simple job to put float switches on the pump and a time clock on the fan motor, the hoisting installation presented an entirely different problem, since the safety requirements incorporated in the Ohio mine laws had to be fully satisfied.

In the rearrangement of the hoist, the steam engine was disconnected from the drum and a motor was geared to the outside of the drum. Limit switches were installed so that the speed of the cage was cut to one-half its normal speed when within 20 ft. of the tipple and within 20 ft. of the mine level. After a little adjustment the cage was made to stop exactly at the track level so that the car could be run off smoothly. Provision was made for safety by installing a slack-cable switch that would automatically apply the motor brake in case the cable broke or developed too much slack. A hand brake was likewise installed so that it could be operated by the man on the tipple.

As arranged, the cage is hoisted automatically, as is an automatic elevator in an apartment house, and is designed so that it can be stopped at the mine level, the ground level, the dump or the tipple, or at any intermediate point. The cage is operated by the loader at the mine level and by the man on the tipple. This eliminated three engineers, making a saving of $21.88 per day. Boiler repairs amounted to approximately $300 per year with the old equipment. With coal figured at $15 per day, the use of electricity has accomplished a net saving of approximately $7,000 per year. Since the complete installation for the mine, including material and labor, cost originally about $7,000, the Heimann Coal Company has realized a return of 100 per cent on its investment in a year's time. Previously the mine turned out an average of only 100 tons of coal a day; under the present arrangement it is able to produce 125 tons of coal a day and with greater ease and using fewer men than before. This increase in production proved an agreeable surprise to the mine superintendent, who was at first very much opposed to the electrification of the equipment, believing that it could not hoist as rapidly or as satisfactorily as by the use of steam power. There has been no trouble whatever with the motorized equipment and the latest advices are that a new mine is shortly to be opened for which a duplicate installation of electrically driven automatic equipment will be desired.



MOTOR IS GEARED TO HOISTING DRUM, WHICH HAS TIME-LIMIT SWITCH ON ONE END

Investment Trusts Help Stabilize Utility Markets

Segregate huge reservoir of private investors' funds, much of which goes into public utility industries

By Dr. J. M. Chapman
Assistant Professor of Banking, School of Business, Columbia University

AS A SOURCE of new capital in finance its expansion and as a stabilizing influence upon security prices, the investment trust, although a relatively new institution in the United States, is rapidly assuming a position of importance to public utility companies. Not only have most existing investment trusts interested themselves heavily in public utility securities but trusts have been formed to deal exclusively in the securities of these companies.

An authority on the subject has stated that starting with less than half a million dollars in 1924, investment trusts in this country now have assets of more than $300,000,000. Another authority places the figure at $500,000,000. It has recently been announced that British investment trusts have holdings of $1,500,000,000 of securities and that they add new investments to the extent of something like $600,000,000 a year. These figures serve to illustrate the importance that investment trusts in the United States may easily assume in the next few years as a source of credit to the public utility and other industries and as a stabilizing factor, since commitments are of considerable duration in the majority of cases rather than merely quick turns for profit.

Gradual extension in the market for public utility securities is an important factor in the future growth of the industry. The investment trust movement, although still in its infancy, promises to be a factor that merits consideration in the future. Dr. Chapman shows in what way the movement is of interest to the utility executive in that it will be a gradually expanding source of capital for investment.

The development of investment trusts in the United States has taken place largely within the past five years. Patterned upon similar institutions in Great Britain, the United States trusts have been adapted to the particular needs and market conditions of this country. The principle upon which they are built, however, is the same. They are nothing more or less than companies or corporations organized to profit from investments in a diversified group of dividend-paying securities, the profits arising from two sources, regular dividends and appreciation in principal. The organization may be either corporate or trust in form. In the most common type the capital stock is either largely or partly subscribed for by the organizers of the trust. Preferred stock and sometimes debentures are sold to the public and the funds thus obtained invested in selected securities. With these securities as collateral, the trust is then enabled to borrow additional funds from the commercial banks for further investment. Experience has shown that British investment trusts are earning from 10 to 16 per cent annually on this stock with comparatively little risk to the investors. Some of the new investment trusts in the United States have demonstrated their ability to duplicate such a record, even in the early years of their existence.

Since neither the federal nor the state laws in general take actual cognizance of the investment trusts in the way of establishing regulations, certain restrictions are usually adopted by the company itself to assure safety for the investors' funds. They relate primarily to three matters—the nature and security of the obligations, the standards adopted with respect to the earning records of companies and the provisions set down to secure diversification. The following restrictions, set forth in the prospectus of the International Securities Trust of America, one of the well-established investment trusts, are typical as regards the standards of diversification prescribed by many investment trusts, most of which have definitely restricted purchases:

1. The corporation will not invest its funds in securities of any corporation or organization unless such corporation or organization or its predecessor has been established for at least four years prior to such investment.

2. Not more than 55 per cent of the corporation's funds will be invested at any one time in securities originating in Great Britain and not more than 35 per cent will be invested at any one time in securities originating in any other nation or country except the United States.

3. Not more than 10 per cent of the corporation's funds will be invested in securities representing any one distinct class of business or industry.

4. Not more than $1\frac{3}{4}$ per cent of the corporation's funds will be invested in securities of any one obligor or issuer except governmental securities and not more than 5 per cent thereof will be invested in the securities of any one government except those of either the United States of America or Great Britain.

5. The corporation's funds will be invested in at least 400 different securities.

6. The corporation will not engage in any promotion, business management or business financing, and will confine its operations to the investment and reinvestment of its resources in seasoned, marketable securities.

The spirit of the last clause is almost universal among investment trusts, it being the accepted policy to trade in the securities of governments, corporations or companies rather than of assuming control by the purchase of a majority of the stock. Many of the trusts guide their policy according to the operations of the companies the securities of which they hold without any intention of influencing the policies of such companies. The directorates are generally authorized to substitute securities and turn over investments whenever it is desirable in the interest of the stockholders. In this way advantage can be taken of market conditions and of factors relating to the operations of the companies concerned.

One of the outstanding features of the investment trust is the exceptionally low operating costs. Statistics

show that the expenses of the English and Scottish investment trusts range from 0.27 to 0.63 of 1 per cent of the issued capitalization of the company. Although few United States companies have been able to duplicate this record with regard to the cost of operations, the most successful trusts have very low operating ratios.

One large investment trust dealing almost exclusively in public utility securities is the Electric Investors, Inc., which is controlled by the Electric Bond & Share group. This company has a minority interest in 31 of the country's largest public utilities, and these constitute about 83 per cent of its holdings, or something in excess of $27,000,000. The investments held include utilities operating in practically every section of the country as well as abroad. Practically every type of public utility is represented, so that diversification is unusually wide. The lists also include a sprinkling of industrials. Another organization, the United States Electric Light & Power Shares, Inc., was recently established to invest exclusively in securities of United States light and power companies. Capital has recently been raised by this company for investment in utilities operating, it is stated, in every state and including companies serving the nation's 50 largest cities. Other trusts are investing huge amounts of new money in these securities annually.

Apart from the companies that are exclusively or almost exclusively interested in utility securities, a number have invested heavily therein. In most cases the company's bylaws stipulate the percentage that may be invested in utilities; in most cases it is relatively high. In the case of American Founders Trust, 35 per cent of the total resources is the limit set. International Securities Trust of America has set a 10 per cent limit upon utility holdings, and the Second International Securities Trust of America has placed the limit at 25 per cent. Of the other larger investment trusts, some have and others have not placed a limit upon the volume of these securities.

It is thus evident that investment trusts are relatively large investors in public utility securities. An attempt has been made to ascertain at least an approximation of the total of public utility securities held at the present time by investment trusts in the United States. Figures are not obtainable from all the companies, but the data assembled suggest a figure in the neighborhood of $100,000,000. Although this is not a large percentage of the aggregate of public utility securities outstanding, the total suggests the potential importance to the public utility industry of a movement that is of such magnitude although still only in its infancy.

Small Heat Applications Open Field for Larger Units

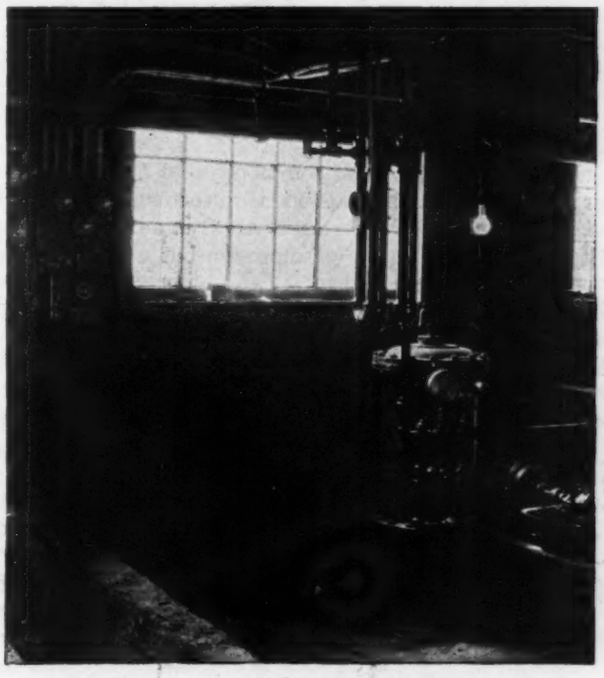
By W. H. Snyder
Wisconsin Power & Light Company, Sheboygan, Wis.

MOST large industrial electric heating installations are the result of a small initial application which proves its merit and leads to more extensive use of electric heat in process work. Even very small installations of heating load are worthy of serious consideration, as this type of equipment will bring a desirable load and consume more kilowatt-hours than many other devices costing a great deal more and necessitating much more engineering and cost of installation and upkeep.

The Polar Ware Company of Sheboygan, Wis., manufactures high-grade kitchen, enamel and aluminum ware, and uses oil fuel for firing the enameling furnaces, smelter and three air driers. The oil for this heating is contained in a large storage tank, which is heated to approximately 125 deg. by steam coils placed within the tank. During the warm months of the year it was necessary to maintain a fire in the boilers for the sole purpose of heating the oil during the night period of operation. In order to save this expense, as well as to raise the heat of the oil, General Electric immersion heaters were installed in the pipe line; this raises the temperature of the oil and does away with firemen during the summer nights and enables a better burning of the fuel. The oil enters the heaters at 125 deg. and with 5 kw. connected and controlled thermostatically, a temperature of 190 deg. is maintained constantly.

Over a test period of four days it was found that approximately 1,000 gal. of oil was burned per day in the six applications already mentioned and approximately 1,000 gal. of oil per day was by-passed after being heated and returned to the main supply tank. With this four-day test only 300 kw.-hr. was consumed by the heaters, which, at the rate obtained on power service, is almost a negligible item compared with the savings effected.

It is estimated that this installation, costing roughly $100, will consume between 2,000 and 3,000 kw.-hr. per month, which compares more than favorably with any other type of load.



THREE 2½-KW. DOUBLE "U"-SHAPED IMMERSION HEATERS HEAT THE OIL

On account of the success of this installation, the Polar Ware Company is contemplating the installation of a 15-gal. water heater and also some electric furnaces for experimental uses.

Letters from Our Readers

Shaded Light and Refixturing Campaigns

To the Editor of the ELECTRICAL WORLD:

That there exists need for great improvement in the lighting of the average American home has been so evident a fact to all who appreciate what home lighting might be if properly planned that many dollars have been spent in the past five years by various interested branches of the industry in trying to bring about an improvement. A point has now been reached where there is prospect that this expenditure may show results. The kitchen-lighting campaigns as carried on in many places have been the entering wedge, and the refixturing or home-lighting campaign movement that is now getting fairly under way in numerous power-company organizations has the possibility of great good or evil to the cause of better lighting in the American home.

If the luminaires, whether fixtures or portables, offered in these campaigns are of correct technical design as well as pleasing in appearance, some real improvement in home lighting can be expected as a result. If the new luminaires simply continue former atrociously glaring methods of lighting in a new dress, the effort put into these campaigns might better be spent some other way. Not but that it is entirely in order for the fixture manufacturer and dealer to advocate changing of fixtures solely for the purpose of bringing them up to date in style, and even in the campaigns of the power companies the same argument is no doubt one of the most powerful that is used; but so much more can be accomplished by these campaigns than merely a change of styles that any power company which does not recognize more than this aspect of the campaign is losing sight of both its own and its customers' best interests.

For example, the most commonly sold fixture for the living room at the present time is unfortunately one with unshaded lamps. To sell one of these in a campaign may improve the appearance of the room but will rarely improve the lighting. There is the same temptation as before to leave the fixture unlighted, to avoid the glare, and to depend on portables, and the same probability that the sockets will be found only partly filled after the fixture has been in use two years. The company is not getting the revenue and the customer is not getting the improved lighting service that should be the result of a change of this kind.

Another misconception in the selection of luminaires for a campaign like this is due to an overdose of the slogan "shaded light." Shading is for reduction of glare and for ornament, but its legitimate use does not consist in selecting a luminaire of high wattage for the sole purpose of boosting the consumer's bill and then surrounding the lamps with glass of such heavy absorption that the glare is reduced to a tolerable point. To be sure, this method has been pursued many times in the past by the unintelligent, but a great power company with the best of expert advice at its command and with executives who are supposed to have at least a little knowledge of the principles of illumination does not properly belong to this class. While ornament is often secondary to efficiency in home lighting, there should be a reasonable regard for "chasing gloom" as well as for "chasing glare," and "chasing gloom" is not likely to be accomplished when so large a part of the generated light is wasted in this way. Up to the present time most of the fixtures for home lighting which rate high as to freedom from glare and illuminating efficiency, and are at the same time designed to prevent the use of lamps of too low wattage to give good results, are of designs which make considerable use of indirect or diffused light by reflection from the ceiling.

This statement, of course, does not apply to portables or certain types of dining-table fixtures where properly shaded downward light is the principal result. The Illuminating Engineering Society's specifications for residence luminaires now offer methods of rating which are considerably more definite and authoritative than anything we have had in the past, and if power companies use these as a guide in making selections of luminaires for use in these campaigns, the cause of good lighting in the American home is likely to be more advanced by these campaigns than by anything that has happened for many years. The good work is already under way in numerous communities.

J. R. CRAVATH.

San Francisco, Cal.

Do Central Stations Neglect a Major Source of Good or Bad Public Relations?

To the Editor of the ELECTRICAL WORLD:

The writer is not a member of the public utility industry but feels very sympathetically toward it and toward its problems. A recent personal experience may therefore point a moral to central-station companies. Our family has just moved into a new home. A week before we moved I wrote the local electric light company and asked to have service connected on the day we moved. Back came a printed postal saying that my request had been received and would be taken care of.

Came the day we moved. No electricity had been connected. We telephoned the electric light company. Its staff promised to investigate. Later they told us to get in touch with the electrical contractor who had wired the house. The contractor suggested that we get in touch with the lighting fixture supply house, which had not yet installed all the fixtures. The lighting fixture supply house admitted that all the fixtures had not been installed but insisted we could get electric service just the same and suggested we telephone the contractor. The contractor suggested another talk with the lighting company, which in turn suggested that the electrical contractor get busy and have the wiring inspected.

So on back and forth for a week and no electric service, much to our discomfort and annoyance. That week without service taught our whole family much about the value of electricity in the home. But it also set the writer wondering if central-station companies are paying enough attention to a major source of good or bad public relations—speed or delay in connecting up newly wired homes. Irrespective of who is to blame for delay in connecting electric service, be it the contractor, the inspector or the central-station company, the tendency is to blame the lighting company. Certainly it will pay any central-station company in improved public relations to use as much man power, exert as much energy and take as much trouble as is necessary to connect up new domestic customers in the shortest possible time. First impressions count, and quick service from the local lighting company makes a lasting impression on the new customer.

ARTHUR P. HIROSE.

[Many utilities recognize the opportunity and have men who press along inspections so service can be provided.—EDITOR.]

Digest of Electrical Literature

Hydro-Electric Development and Steam Equipment

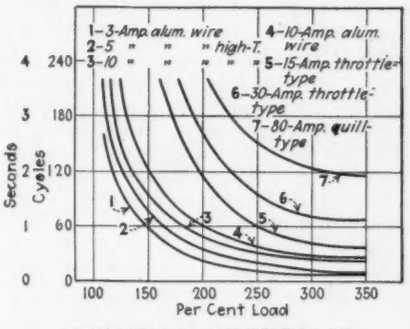
Methods of Controlling Flow of Water.—F. JOHNSTONE TAYLOR.—The author describes the fundamental considerations involved in the various types of apparatus employed in dams for regulating the flow of water, the limitations and hydraulic conditions of the solid weir, the various features of multiple-arch dams and the several related devices for accomplishing the desired results.—*Canadian Engineer,* Nov. 1, 1927.

Pulverized-Fuel Plants.—LEONARD C. HARVEY.—The economic possibilities of pulverized fuel for power-house applications lie not alone with the central system but with the recently developed, self-contained unit system, according to the author. For superpower-station purposes the central system is advocated, but for smaller power stations the unit pulverizers may be more suitable. Progress with the latter has been due to reduction in equipment expense, cost of maintenance of mill parts and power consumption and to the introduction of turbulent mixing of fuel and air supplies. The installations incorporated in a number of representative power houses, with particular reference to the types of coal-preparation devices, are mentioned. The value of the unit system is said to rest upon lower investment costs due to elimination of storage bins, driers, separators, and transport systems, equal furnace efficiencies with less operating and maintenance labor, greater simplicity of installation and cleaner, quieter and probably safer operation. The author concludes that for general application, as in smaller fuel stations, where pulverized fuel shows definite and valuable advantages, the self-contained unit system calls for very close consideration. Unit machines which are readily installed and require no separate housing or transport systems deal with undried fuel and coal of any available quality.—*World Power (England),* November, 1927.

Transmission, Substations and Distribution

Aërial Survey Locates Power Line.—Aërial photography has been successfully used by the Hydro-Electric Power Commission of Ontario in locating the route and in the purchase of easements for the 200-mile, 220,000-volt transmission line now under construction between Fitzroy Harbor, on the Ottawa River, and Toronto. The procedure followed in locating the line is described at great length, from the original layout upon the best available maps, through the actual aërial survey, and terminating in the co-ordination of the prints obtained. Among the advantages discerned in the use of this method of survey are the practical elimination of preliminary field surveys ordinarily accomplished at considerable expense; that hills of various kinds may be clearly and rapidly discerned from an examination of the prints, that features of the terrain which are affected or susceptible to the action of rainstorms, washouts, etc. may be readily located, and reduction of the time and effort necessary to acquire the preliminary information involved in obtaining easements. A permanent record of the territory through which the line must pass is obtained, and this record may prove of tremendous value in eliminating future surveys and analyses. A stereoscopic feature, when employed, permits an accurate estimate of the growth density of the timber land through which a line must pass and a very fair idea of the grades involved.—*Electrical News (Canada),* Oct. 15, 1927.

Measuring Time Lag on Substation Fuses.—J. W. DUNFIELD and L. D. MAHONEY.—The authors have endeavored to investigate by means of a comprehensive series of tests carried out under operating conditions the tendency of the ordinary cut-out to fail to function at its rated load unless great care is exercised in installing the fusing material. The authors conclude that copper wire of suitable size is the best all-around fuse wire for use in standard cut-outs, though it should be carefully made up, doubled and twisted, and that the ordinary fuse cut-out is unreliable inasmuch as the smaller fuses will not blow until about 175 per cent current is on the fuse; that, in order to overcome the time lag and the trouble between high-tension and low-tension fuses in such cases, the high-tension fuses should not be less than 35 amp. and that the low-tension size should be fused as lightly as reasonable, not over 0.5 amp. per phase per kva. capacity of substations. The accompanying figure illustrates some of the time delay features of fusing equipment as encountered in the several tests.—*Electrical News (Canada),* Nov. 1, 1927.



TIME-LAG CHARACTERISTICS OF DIFFERENT FUSES

Generation, Control, Switching and Protection

Calculation of Air Cooling for Generators and Transformers.—M. HOTTINGER.—Electric generators dissipate approximately 5 per cent, and transformers 3 per cent to 0.5 per cent of their output in the form of heat, according to the author. To avoid overheating, this quantity of heat must be carried away. If air cooling is resorted to, natural draft or artificially enforced draft should be sufficiently effective to deal with the specific amount of hourly produced heat. With simple formulas, accompanied by well-chosen practical values, the author shows how to compute the necessary size of air ducts, intake and discharge openings for any size of generator or transformer. Loss coefficients are given for bends in the canals or restrictions, and equations indicate how to calculate the size of ventilator required for forced draft.—*Bulletin de l'Association Suisse des Electriciens,* October, 1927.

Overvoltages on Transformers.—J. KOPELIOVITCH.—The results obtained by theoretical and experimental research work in an investigation of overvoltages due to switching of transformers at no load. The physical causes of these higher-than-normal voltages are the sudden interruption of the magnetizing current, the reforming of the opening arc and the oscillations due to the arc itself. Many tests were made to establish the influence of the iron saturation, the operating frequency, the opening speed of the circuit breaker and the number of breaks per phase upon the amplitude of the resulting overvoltage. The results of an additional series of tests illustrate the beneficial influence of a resistance step breaker. To excess voltages caused on transformers by the disconnection of unloaded transmission lines particular attention is given. It is demonstrated that step resistance switches, combined with multibreaks on each phase, and quick operation will reduce materially overvoltages due to arc formation.—*Bulletin de l'Association Suisse des Electriciens,* September, 1927.

Units, Measurements and Instruments

Bridge-Type Vacuum-Tube Voltmeter.—ISAMU YAMAMOTO and KIGOSHI MORITA.—A new type of vacuum-tube voltmeter designed by the authors for the purpose of measuring very small alternating voltages is discussed in this article. The device consists of a balanced high-resistance bridge, two symmetrically placed triode rectifiers and a D'Arsonval-type galvanometer. The application of a small voltage to one cor-

ner of the bridge and of an auxiliary voltage of the same frequency to another corner will cause the galvanometer to give the deflection proportional to the scalar product of these two voltages. The voltage sensitivity of this voltmeter arrangement may be varied by choosing the auxiliary voltage over a wide range, the maximum sensitivity obtainable being 2.4 mm. for one millivolt. The advantages of the arrangement are portability, ease in handling and high sensitivity. A shortcoming of the device is the slight instability of the zero position of the galvanometer. It is stated that this apparatus may be used conveniently for the precise comparison of high-frequency currents and that differences of but one-tenth of a cycle may be readily detected.—*Journal of Institute of Electrical Engineers of Japan*, November, 1927.

Illumination

The Mechanical Strength of Metal-Filament Electric Lamps.—F. MURGATROYD.—The author has endeavored to deal with the subject of mechanical strength of electric lamps from the user's point of view and has supported many of his statements and conclusions by experimental data. A brief review is offered of light efficiency in connection with these lamps, and the use of inert gases, spiral filaments and anti-vibration fittings is discussed to some extent. It is stated that the strength of the complete lamp depends upon a number of factors, but the main and most essential one is the nature of the metal filament, while the general construction of the lamp and the method of filament support are secondary. The exposition accordingly centers upon the grain growth and size in the crystalline structure of the tungsten filament, and a discussion of the fundamental weaknesses of the material is offered. The effect of stress upon deformation and temperature has been considered, and vibration is considered to offer an unbalancing factor in such determinations. The main effect of vibration is to produce fatigue, so that the metal fractures more readily. It is also stated that vibration may bring about a modification of crystal orientation and that the temperature and initial grain size may be affected by such action. The transition temperature of tungsten receives attention. As a result of these tests the author concludes that the main facts established are that a lamp is weaker when burning than when cold, that gas does not add to the strength of a gas-filled lamp, that spiral filaments are not necessarily stronger than straight ones, and that the chief factor is the structure of the filament material. Until the objections attendant upon the use of spiral-formed filaments are overcome it is not anticipated that in the smaller lamps any other than straight wires will be used. It is stated that greater resistance to shock might be obtained by redesigning the filament mount slightly so that the distance between adjacent lengths may be increased or the distance between top and bottom supports may be decreased. — *Engineering (England)*, Nov. 4, 1927.

Motors and Control

Parasitic Current Losses in Bar-Wound Direct-Current Armatures.—F. W. CARTER.—A discussion is offered of the nature of the parasitic current set up in an armature bar upon reversal of the current by the commutator, and an indication is given as to how the additional loss in the bar due to this current may be determined as a fraction of the loss due to the effective current. The discussion is almost entirely mathematical. The author states that when an armature winding is composed of deep bars embedded in slots and a current in the bars produces a magnetic field crossing the slots it is apparent that the lower portion of the bar is encircled by a greater amount of flux than the upper portion. Any change in the current carried by the bar is resisted to a greater extent at the bottom of the bar than at the top, and the latter portion is accordingly most affected by fluctuation of the current. During commutation, for example, the reverse current appears first at the top of the bar, and the resistance loss is therefore greater than would have been the case had the current been distributed evenly over the section. The present investigation may be regarded as an application of Field's analysis. The assumption is made that reversal takes place at a uniform rate. The variation of current with time is accordingly assumed to follow the form of the curve. Calculations are carried to a conclusion for a specific example.—*Journal of Institution of Electrical Engineers (England)*, November, 1927.

Heat Applications and Material Handling

Large Carbide Furnace.—P BERGEON.—Arc furnaces of large capacity are usually made with a number of movable electrodes, because it has been found difficult to concentrate more than 2,000 kw. in one electrode. A 6,000-kw. furnace with three electrodes or a 12,000-kw. type with six electrodes is stated to be standard practice. Electrical and mechanical complications, combined with crowded space where freedom for action would be desirable, are the disadvantages of the multiple-type furnaces. A French designer has succeeded in constructing a single-phase furnace with only one movable electrode for capacities between 5,000 kw. and 25,000 kw. A 6,000-kw. carbide furnace of this type operating in a French plant is described. The trough of the furnace carries the bottom electrode, while a specially built 8-ft. diameter round-carbon cylinder forms the movable center electrode. A 50-cycle current of 110,000 amp. flows normally through the arc. Very carefully interlaced cables, with their short run owing to the placing of the transformer directly below the furnace, are responsible for the unusually favorable power factor of 0.95 of this installation. A consumption of 3,000 kw.hr. per metric ton of calcium carbide has been achieved. — *Revue Générale de l'Electricité*, Nov. 12, 1927.

Electrophysics, Electrochemistry and Batteries

On Electrets.—EDWIN P. ADAMS.—The study of permanently polarized dielectrics has been undertaken by several investigators. The author has endeavored to amplify the original determination made by Eguchi, in which he discovered that mixtures of certain waxes when allowed to solidify from a molten state in a strong electric field appear to possess permanently polarized characteristics. A number of determinations were made in an effort to investigate the permanency of this effect and the various factors which produce and alter the situation. The author concludes that the evidence developed in this article indicates that the so-called permanent electrets are not permanent, but that their polarization decays with time. In room temperatures this decay is too slow to be observed directly, but it is the decay of polarization that at least in part accounts for the presence of the free charges that are always observed. At higher temperatures the results that have been obtained are consistent with a view that the rate of decay and the polarization increase very rapidly with the temperature, so much so that the polarization may be almost completely destroyed at a temperature which is not high enough to cause any appreciable softening of the waxes that form the substance of the electrets. In accordance with the hypothesis of Lord Kelvin regarding the cause of pyro-electricity, these electrets have been shown to possess the pyro-electric property. The piezo-electric effect which always accompanies the pyro-electric property is also shown to be present.—*Journal of Franklin Society*, October, 1927.

Miscellaneous

Symbols for Heat and Thermodynamics. — The scientific and engineering symbols and abbreviations tentatively proposed as an American standard and prepared by the sub-committee of the sectional committee on scientific and engineering symbols has been presented for discussion. In carrying out its work the sub-committee has studied lists of symbols pertaining to this subject which have been issued by other engineering organizations in this country and abroad, and in compiling this tentative list the symbols relating to the subject of heat transmission have been omitted pending the publication of the report of the National Research Council committee on heat transmission. This proposed standard is now being issued for criticism and comments.—*Report of American Engineering Standards Committee.*

News of the Industry

Big Plant for Wilmington

American Gas & Electric and American Electric Power Will Build Joint Station on Delaware Opposite City—Ultimate Rating 400,000 Kw.

ANNOUNCEMENT has just been made by Stevens & Wood, Inc., of 120 Broadway, New York, that they have signed a contract covering the design and construction of a steam-electric power station on the Delaware River, opposite Wilmington, Del., to be known as the "Deep Water" station. It will be jointly owned by the American Gas & Electric Company and the American Electric Power Corporation and will supply power for the Atlantic City Electric Company and the Delaware Electric Power Company, formerly the Wilmington & Philadelphia Traction Company, which are respectively subsidiary companies of the holding companies first mentioned.

The plant will be built on the New Jersey side of the Delaware River at Deep Water Point. It will be designed for an ultimate capacity of about 400,000 kw., it being probable that the initial installation will consist of two units, each rated at approximately 50,000 kw. In designing this plant consideration is being given to the use of 1,200-lb. boiler pressure. It is expected that the station will be ready for commercial service about the end of 1929.

Interconnection Experiment, Chicago to Pensacola

For about fifteen minutes on Saturday, Dec. 3, there was established a complete electrical connection from Chicago to Pensacola, Fla., over lines spanning a distance of approximately 1,000 miles. Particulars of this experiment have just become available. No power transmission occurred, but the systems proved very stable. The connection was from the Commonwealth Edison Company system to the Indiana & Michigan property of the American Gas & Electric Company, thence through Ohio to the Appalachian system in West Virginia and on to Kingsport, Tenn. From Kingsport, through the Tennessee Eastern Electric Company, the connection was with the Knoxville (Tenn.) system and thence south through the Alabama Power Company's lines to Pensacola.

This connection was made possible by the recent completion of the 132-kv. line to Kingsport from Logan, W. Va., and Saltville, Va. (see ELECTRICAL WORLD for Oct. 8, page 752) and of a 132/110-kv., 25,000-kw. tie-in with the system in eastern Tennessee. A 10,000-kw. swing on the light 66-kv. tie line between the Commonwealth Edison and Indiana-Michigan systems was the only weakness reported. This interconnection exceeded in length the interconnection between Chicago and Boston established a year ago (ELECTRICAL WORLD, Nov. 27, 1926, page 1131) and was a more valid accomplishment in that no frequency changers intervened.

Edison Medal to Coolidge

Contributions to Incandescent Electric Lighting and the X-Ray Art Bring Coveted Award to General Electric Company Research Engineer

AWARD of the Edison medal to Dr. William D. Coolidge, assistant director of the research laboratory of the General Electric Company, "for his contributions to the incandescent electric lighting and the X-ray arts," was announced on Wednesday by the Edison medal committee of the American Institute of Electrical Engineers.

W. D. COOLIDGE

William David Coolidge, physical chemist, was born in Hudson, Mass., Oct. 23, 1873. He is a graduate of the Massachusetts Institute of Technology and of the University of Leipzig and has been assistant in physics, instructor in physical chemistry and assistant professor of physico-chemical research at the Massachusetts Institute of Technology. Dr. Coolidge became associated with the General Electric Company in 1905 and became assistant director of the research laboratory in 1908. He was awarded the Rumford medal in 1914 for the invention and applications of ductile tungsten. He is a member of many scientific bodies, including radiological societies in Europe.

No Westinghouse Electric Chairman Yet Selected

Denial by Matthew C. Brush of a report that he would succeed the late Guy E. Tripp as chairman of the Westinghouse Electric & Manufacturing Company has been followed by an authoritative statement from the Westinghouse office that Mr. Brush had not been considered for this position and that no particular person was as yet in view for the chairmanship. It is stated, furthermore, that a rumor to the effect that an internal contest has arisen regarding the chairmanship is entirely without foundation and that no conflict of interests exists.

Plans for Electrification of "Narrow-Gage" Road

Plans for the electrification of the Boston, Revere Beach & Lynn Railroad, commonly known as the "Narrow-Gage," at a cost of more than $1,000,000, are announced by Hemphill & Wells, New York, who are financially interested. The project, which will require the approval of the Department of Public Utilities of Massachusetts, involves the construction of two substations and one portable substation to distribute electrical energy, the construction of an overhead system of catenary type with 600 volts direct-current supply, the reconstruction of rolling stock, the present passenger cars to be transformed into cars of "de luxe" type and equipped with 50-hp. General Electric motors, two to each car, and modernization of all terminals. The automatic prepayment fare system will be installed and flexible service maintained to meet the demands of heavy traffic. The narrow gage will be retained, three feet for the entire system of 34 miles. It is expected that the work will be completed within nine or ten months.

Cleveland Electric Illuminating to Install New Unit

Increasing demand for electricity due to the development of the Greater Cleveland district will be met by an increase of 35,000 kw. in the generating capacity of the Cleveland Electric Illuminating Company's system in 1928. A new turbo-generator of this rating will be installed at Avon station, bringing the installed capacity of the plant up to 105,000 kw. Preliminary work for the installation of the new unit has just been started, and it is expected to be in operation on or about Aug. 1.

The new unit will occupy berth No. 3 in the Avon plant, leaving room in the

present building for the installation of only one more turbo-generator. The new generator will be similar in design to units No. 1 and No. 2. With it will be installed two additional boilers of the Sterling twin type, with a rating of 3,060 hp. each and capable of being operated at three times this rating. Another stack will be constructed, similar in appearance to the two which now surmount the building. The stack will be 17 ft. in diameter and will rise 175 ft. above the roof of the building, or 305 ft. above the ground level. Two 15-ton coal-pulverizing mills with accessory equipment will also be installed.

When this turbo-generator goes into operation next August, it will bring the total generating capacity of Avon station and Lake Shore station, which are interconnected, to 476,350 kw.

Lafayette Meetings Score Great Success

Great Lakes Engineering Section and National Meter Committee Attract 350 Men — Purdue University and Duncan Company Joint Hosts

AN EXTRAORDINARILY successful series of meetings of the committees of the Great Lakes Engineering Section and of the national meter committee of the National Electric Light Association held at Lafayette, Ind., last week could, from the standpoint of attendance—more than 350—quite properly have been characterized as a convention. The large attendance was due to the open meetings of the Great Lakes meter committee, to which a widely accepted invitation was extended to all meter men and others interested. No small part of the success of the four-day affair, Dec. 7 to 10 inclusive, must be ascribed to the joint hosts, Purdue University and the Duncan Electric Manufacturing Company.

Except the meetings of the national meter committee, all of the sessions were held in the new electrical engineering building of the university. At the open meetings of the first two days, which were presided over by Stanley Green J. C. Langdell described meter conditions in Europe. The importance of meter men in the development and maintenance of good public relations was stressed by A. E. Scott, and B. W. Sinclair recounted the results of a study of jewels and pivots. F. H. Moore spoke on the relation between the electrical inspector and the meter man, and secondary reference standards were enlarged upon by L. D. Snyder. The use and application of high-speed graphic instruments in power systems and in industry and the operation of power system relays were treated by D. J. Angus and S. M. Durst respectively.

The proceedings of the second day were opened with a paper by F. L. Pavey on watt-hour-meter characteristics, after which the work of the national meter committee was explained by E. E. Hill. The substitution of mechanical cut-outs for fuses in domestic installations was explained by W. L. Wadsworth, and F. C. Holtz discussed modern meter developments. William Bradshaw, in speaking of the advancement of the metering art, made clear the responsibilities and risks assumed by manufacturers in the introduction of even slight changes. W. R. Hirst spoke on safety practices as affecting meter work.

The meetings of the committees of the Great Lakes Engineering Section, under the general chairmanship of F. E. Andrews, while mostly concerned with organization for the work of the coming year, were productive of much interesting discussion. The overhead systems committee gave pungent consideration to conductor insulation at various voltages and to the reaction of juries to so-called expert evidence in damage suits, while the underground men exchanged experiences with cable joints and methods of installation. Inductive co-ordination, safety, prime movers, the burning characteristics of local and other coals, hydraulic power and electrical apparatus all were discussed.

The deliberations of the national meter committee covered a proposed correspondence school for meter men, the use of meter records for auditing billing-date and customers' accounts and the requirements for service entrance switches. The proposed 2.5-amp. meter came in for discussion, as did also the development of general operating rules for meter departments.

There were no less than three banquets in the four days. The first was given by the Duncan Electric Manufacturing Company, when Dr. E. C. Elliott, president of Purdue, was the principal speaker. At the second, which was the annual dinner of the Great Lakes Engineering Section, E. C. Stone, national chairman, explained the responsibilities of the N.E.L.A. committees and fourteen others spoke briefly. The third banquet was given by the Duncan company to the national meter committee.

Muscle Shoals and Rivers Commission Bills

Chairman Madden of the House appropriations committee has reintroduced his bill which would authorize leasing of Muscle Shoals to the Air Nitrate Corporation and the American Cyanamid Company.

Provision for a Waterways and Water Resources Commission, composed of a chairman (appointed by the President), the Secretary of War, the Secretary of Interior, the Secretary of Agriculture, one senator, one representative and one economist, which shall co-ordinate all government work relating to waterways and water resources with a view to improving and regulating navigation, control of floods, utilization of water power, and conservation of water, is made in a House bill, just introduced by Representative O'Connor of Louisiana.

Steps to appropriate $15,000 to be expended in efforts to obtain adoption of the Swing-Johnson bill for the construction of the Boulder Canyon dam were approved on Dec. 2 by the City Council of Los Angeles.

Public Learning About Boulder Dam

Congressmen Fresh from Their Districts Reflect Adverse Sentiment of Their Constituents—Senator Johnson No Longer So Confident of Bill's Passage

By Paul Wooton
Washington Correspondent of the Electrical World

THAT the public has learned enough of Boulder Dam to appraise the situation for itself seems evident from the attitude of federal legislators who just have returned from their districts for the opening of Congress. It has become widely known that the cost of the project is likely to exceed $200,000,000. It is realized also that there will be heavy carrying charges on a scheme of this size and that a long period must elapse before a market can be developed for so large an amount of new power.

Moreover, there is a widespread feeling that the reductions being made in the cost of steam power may make it impossible to sell hydro power at a profit eight or ten years hence. In such a case the prospect of securing a return of the $200,000,000 of taxpayers' money would disappear and the government would have on its hands a property that would be many times more troublesome than Muscle Shoals. Apparently taxpayers are wondering why the government should go into the power business on the Colorado River when private capital is willing to develop the river gradually and bring power into the market in such quantities as can be absorbed. It has been learned also that Congress long has been willing to vote the relatively small amount necessary for flood control.

Even Senator Johnson does not seem to be very optimistic as to the prospects of his bill. In a statement just issued he is not so cocksure of its passage as he was. "We shall go forward as best we can with the bill in Congress," he says. "Telegraphic advices from California advise me that negotiations are being actively carried on at the present time to compose the differences existing among the states. I am hopeful that these negotiations may result in an agreement. I know that California will go the limit in the endeavor to reach an adjustment. I feel that it is by no means impossible that within a very brief period the lower basin states will present a united front."

Massachusetts Department Files Bill

Bay State Regulative Body, Opposing Reproduction Cost as Basis of Valuation, Proposes Legislation for Reciprocal Understanding with Utilities

LEGISLATION has been recommended to the next General Court of Massachusetts by the Massachusetts Department of Public Utilities authorizing electric and gas utilities to enter into an agreement with the state under which their rates would be regulated by the board on a basis providing for a readjustment of capitalization along the following lines: A readjustment of the capital of any company which applies for such readjustment upon a basis which permits the capitalization of the premiums heretofore paid in and any earnings that have been plowed into the property at the expense of the stockholder who has not received on the average a return on his investment of 7 per cent, provided also that it shall not be capitalized beyond its fair value as determined by the department or beyond the amount expended for its property used and useful in the transaction of its business.

The adjustment of the capital in this way is to effect a contract with the state by which the company agrees that it may be regulated by the state in such manner as the state may determine, so long as such regulation does not prevent it from paying dividends upon its stock adequate to maintain such stock at par. The bill also provides, as to those companies which do not take advantage of it, that the provisions of the law requiring a municipality to purchase a company's property before entering the business of electrical or gas supply (if the company elects to sell) shall not apply. The proposed statute also takes away the right of eminent domain and the power to increase their capital stock and bonds from companies not electing to come under the provisions of the bill.

The proposed act has been drawn up by the commission as a means of trying to strengthen its position in reference to future regulative practice as it may be affected in Massachusetts by the final disposition of the Worcester Electric Light Company rate case now before the United States court following an appeal to that authority against the recent decision of the board declining to recognize reproduction cost less depreciation as the proper rate base in Massachusetts.

In a long communication accompanying the bill filed the Department of Public Utilities says:

Danger of the so-called United States Supreme Court doctrine being enforced in this commonwealth is so great that we think we should at this time make preparations to avoid the results of such a doctrine. This doctrine promotes greed and gluttony upon the part of the public utilities. It asserts that the owners of the utilities are entitled to retain and earn a profit upon excessive earnings which they may have exacted from the public. It asserts that the public has no real control over these utilities, other than an ineffectual method of regulating rates, notwithstanding that the public gives them the exclusive rights in the highways and confers upon them the sovereign power to take private property by eminent domain.

Moreover, it asserts that the property of the utility is increased in value by improvements in the public highways and that the owners of the utility are entitled to increased earnings by reason of these improvements and of the enhanced value upon its property resulting from the growth of the communities. It also asserts that the owners of the utility are entitled to earnings upon the reproduction value of the property less depreciation, notwithstanding that the service performed by it could be performed as well if not better by property that would cost much less.

Stands for Historic-Cost Rate Base

L. O. Whitsell of the California Commission Sees Threat of Public Ownership for Utility Companies That Refuse to Abide by It

SPEAKING in Los Angeles recently, Leon O. Whitsell of the California State Railroad Commission made a statement which was, in effect, a warning to the utility companies of the state that if they continue to insist on reproduction cost new or present "going-concern" value as a basis for property valuation in rate cases, they will strengthen against themselves the threat of municipal ownership. The two conflicting theories concerning property valuation are destined to be fought out in the immediate future, in the opinion of Mr. Whitsell. The commission champions the historical-cost method while the utilities have advocated reproduction cost at current prices, plus "going-concern" value. A quasi-official expression of the sentiments expressed by Commissioner Whitsell is as follows:

"'Going-concern' value has never been allowed by the California Railroad Commission, it being considered highly intangible and speculative, one authority characterizing it as 'invisible, intangible, existing only in contemplation of law and having no place in the economic structure of public utility finance.' I am satisfied from my observations throughout the state that the great majority of the people of California are in accord with the Railroad Commission in its adoption of the prudent investment theory and also in its refusal to allow going-concern value.

"If, in the face of this opinion on the part of the people of the state, the utilities continue to insist upon value being based upon the highly speculative reproduction-cost-new theory and upon alleged going-concern value, in my opinion it will result in the question of public ownership of public utilities ceasing to be a mere academic question and becoming a vital reality in the economic and social life of the state.

"If the commission is forced by decisions of the higher court to permit a return upon a rate base inflated while the high price is still current, it will not be because the commission believes in the fairness of such a method, but because it is compelled to permit such return by the courts."

Ohio's Attorney-General Hails a Court Decision

A decision of the United States Circuit Court rendered recently in Missouri, in the St. Louis & O'Fallon Railroad case, will be of tremendous value to the State of Ohio in the matter of public utility rate making, according to Attorney-General Turner of that state, who construes the decision as upholding valuation for rate-making purposes based on original rather than on reproduction cost. Before the Ohio Public Utilities Commission the Ohio Bell Telephone Company is now seeking to make the reproduction cost of its property the basis of its new rate-making valuation. Attorney-General Turner, who is handling the case for the state, is attempting to break down this contention and to obtain a decision which will take into consideration historical cost and prudent investment as a basis for determining values.

"The main trouble with the utilities is that they are being run by the investment bankers," Mr. Turner is quoted as saying. "The users of the public utilities 'get it going and coming.' They are being overcharged as to rates and they are being compelled to pay exorbitant charges on the increased value of real estate owned by the utilities on which stocks and bonds have been issued. Under the principle of allowing rates to be based on the reproduction cost of the property, the bankers are putting into the property every dollar they can. They are building expensive plants and the increased value of the real estate is being made the basis of more issues of securities on which the public is forced to pay additional revenue."

S.E.D. Elects Two Additional Directors from Leagues

Complete electrical league representation on the directorate of the Society for Electrical Development has been rounded out through election to the society's board of directors of Roger A. Gordon, general sales manager of the Blackstone Valley Gas & Electric Company, Pawtucket, R. I., and E. M. Ashworth, general manager Toronto Hydro-Electric System, Toronto, Ontario. Both are members of the League Council. These appointments give the leagues six places on the board, the other four being filled by J. E. North, president of the Electrical League of Cleveland; H. A. Brooks, commercial

manager of the Potomac Electric Power Company, Washington; R. Bourke Corcoran, manager of the Electric Association, Chicago, and David C. Birdsell, Decorative Lamp & Shade Company, Philadelphia.

High-Rate Combustion Is Canvassed by A.S.M.E.

Arguments for It Presented at New York Convention — Wickenden on Relation of National Engineering Societies to Technical Education

ELECTION of Alex Dow, president Detroit Edison Company, to head the American Society of Mechanical Engineers was noted in the preliminary report of the winter convention of that society printed last week (page 1213). The central-station power session on Thursday drew a large audience. Prof. E. A. White gave a progress report on researches devoted to finding metals or alloys adapted for high-pressure and high-temperature steam. Much work along these lines is under way in this country and in Europe, but no positive data are available as yet.

The paper by E. G. Bailey, president Fuller-Lehigh Company, dealt with results of steam generating-unit installations where attempts had been made to get very high heat-transfer rates. In the new furnaces turbulent mixing of pulverized fuel and air and high velocity of feeding were utilized to get heat-transfer rates up to 120,000 B.t.u. per square foot of heating-surface area, and plants were operated with average rates of 40,000 to 60,000 B.t.u. These figures are much larger than those customary in older boiler practice. The fusing temperature of the ash, turbulent mixing, temperature of furnace and time for combustion were accented as important factors in steam generation.

In a companion paper Henry Kreisinger, research engineer with the Combustion Engineering Corporation, and T. E. Purcell, general superintendent of power stations, Duquesne Light Company, showed operating data on some large steam generating units. Charts showing service performance at high ratings were exhibited, and the authors advocated using a single generating unit, a turbo-generator combination with pulverized-fuel firing.

In the discussion which followed Alex Dow said that he as well as other engineers had merely enlarged furnace volume up to this time and had not changed heat absorption rates or boiler designs very greatly. The new school of thought which urged high-rate combustion seemed to him to make out a good case, and Mr. Dow indicated that he was favorably disposed toward this practice. J. E. Worker asserted that stokers could give high rates of combustion and had been improved to a degree where they can supply more fuel than the boiler and furnace can use. He challenged the statement of Messrs. Kreisinger and Purcell that only pulverized fuel could be considered seriously. I. E. Moultrop said that the quest for high thermal efficiency should be weighed against fixed-charge increases, and he showed curves to bring out this point.

At the meeting of the committee working on higher-pressure and higher-temperature steam-table data a progress report was rendered. Preliminary values submitted last year have checked closely, and the near future should give working data up to 3,200 lb. and 1,200 deg., the committee said. More precise values of data previously available were made public. It was, for instance, observed that the best value of the mechanical equivalent of heat, based on the latest experimental work at the Bureau of Standards, now seems to be 778.4 ft.-lb. per B.t.u.

E. L. Robinson of the General Electric Company presented data on reheat factors for steam turbines recalculated by Prof. R. E. Clark of Cornell University, on the basis of the most recent data on the properties of steam. Dr. Harvey N. Davis of Harvard described his work in calculating and co-ordinating experimental data to obtain the figures that will appear ultimately in the steam tables.

A feature of the convention was a paper on the relationship between industry and taxation by Dr. T. S. Adams, professor of economics at Yale University.

W. E. Wickenden, director of investigation for the Society for the Promotion of Engineering Education, addressed a large audience on "What National Engineering Societies Can Do for Engineering Education." He said: "So far American engineering education has been controlled by professional educators. There has been little fostering or guiding of schools by the profession itself. There has been no protection for schools maintaining high standards and no pressure toward high standards on schools that fail to maintain them. It is true that this policy of *laissez faire* has spared education the evils of arbitrary standardization, but it has cost the loss of much that would be good."

Mr. Wickenden proceeded with a detailed study of how to extend the influence of the profession on education and presented the findings of a questionnaire. He proposed the pooling of interests by the national societies and the Society for the Promotion of Engineering Education through the organization of a joint committee to guide the establishment of engineering standards.

New York Electrical Credit Men Have Good Meeting

"Collect Your Accounts" was the subject of a racy paper given by R. M. Rice of Manning, Bowman & Company, Meriden, Conn., before the thirty-second annual meeting of the New York Electrical Credit Association at the Hotel Pennsylvania on Tuesday of this week. E. R. Mellen of the Weston Electrical Instrument Corporation, Newark, N. J., dealt with radio credit problems, and "Forging Ahead in the New Year" was the title used by Stanley A. Dennis, editor of the *Electrical Record*. At the banquet William R. Conklin, retiring president, was toastmaster. Creighton J. Hill of Babson's Statistical Organization and Champe S. Andrews of New Haven were the speakers.

New officers elected are: President, L. R. Edwards, Harvey Hubbell, Inc., Bridgeport, Conn.; vice-president, J. H. Lecour, New York; treasurer, N. W. Belmuth, New York; secretary, W. J. Kreger, New York.

Purchases and Mergers

Rockford (Ill.) Electric Company Changes Hands—Pacific Gas & Electric to Merge Several Subsidiaries—High Bid for Kinston (N. C.) Plant?

THE Rockford (Ill.) Electric Company has been purchased by the Central Gas & Electric Company, a subsidiary of the Central Public Service Corporation. The Rockford company has 50,000 kw. in generating capacity and serves about 100,000 persons in that city and adjacent communities. It was formerly controlled by the American Gas & Electric Company. No price is announced.

The Pacific Gas & Electric Company has sent a letter to holders of preferred stock of the Coast Valleys Gas & Electric Company, the Western States Gas & Electric Company of California and the Western States Gas & Electric Company of Delaware, all of which it controls, offering to exchange stock and saying that it is intended to merge the companies and ultimately liquidate and dissolve them.

Application for authority to purchase the Quincy (Ill.) Gas, Electric & Heating Company has been filed with the Illinois Commerce Commission by the Central Illinois Public Service Company.

The Interstate Public Service Company has asked the Indiana Public Service Commission for authority to buy the Holton Electric & Power Company, operating in Holton and Nebraska, Ind., for $15,040.

The Orange & Rockland Electric Company, Tuxedo, N. Y., has filed a certificate with the Secretary of State merging with the Tuxedo Electric Light Company.

The Georgia Power Company is reported to have purchased the Jefferson (Ga.) Electric Company.

Drummond, Okla., will sell its municipal lighting plant on Jan. 5 to the highest bidder. Breckenridge, Okla., will vote on Jan. 10 on the sale of its plant to the Oklahoma Gas & Electric Company.

Yuma, Colo., will submit to the voters a proposal to sell the municipal electric plant to the Commonwealth Utilities Corporation. It is expected that the sale will be ratified.

"New York interests" will bid $750,000 or more for the electric plant at Kinston, N. C., if advices from that place are to be believed. The Mayor and other officials declined to verify the rumor, but admitted a "flattering offer." The power house is generally appraised at not more than $500,000.

World Power Conference for International Interconnection

The Federal Power Commission is in receipt of a communication from the secretary of the international executive council of the World Power Conference transmitting a resolution passed by the council at its annual meeting, held in Cernobbio, Italy, in September. This resolution, not previously reported, makes an appeal to the governments or "appropriate national organizations" of the various nations "to facilitate by all means in their power the operation of such [interconnected transmission] systems, nationally and internationally, and to remove all crippling restrictions and burdens which may tend to increase the price of electrical energy or to hinder the development of national or international interconnected systems."

The resolution is the result of discussions which took place in the sessions of the World Power Conference at Basle, Switzerland, in 1926 and was proposed by members of the conference from Switzerland, a country which engages extensively in international exchange of power. The resolution has particular application to the situation in Europe, where, on account of limited national areas and the many international streams, possibilities of electric power interchange across national frontiers are numerous. Its only application to the United States is in relation to interchanges with Canada, or possibly with Mexico.

How New York Power & Light Met November Flood

The floods of last month, though their main fury was vented in Vermont and New Hampshire, also made themselves felt in upstate New York. How the New York Power & Light system exerted itself to save plants and restore interrupted service quickly is told in a company publication, the *Synchronizer*, just issued.

The greatest damage occurred at the Johnsonville hydro-electric station, on the Hoosick River, where the water reached a level of 7 ft. above the station floor, flooding the generators, exciters and a large part of the control equipment. The force of the stream hurled trees, logs and floating debris against the building, breaking in the door and windows and hurling the floating material against the equipment. Drying out was soon under way, but it was necessary to shut down the station for several weeks. At Schaghticoke, also on the Hoosick, the water all but reached the floor of the station, having entered the generator pits. The flooding of the bearings and governor oil storage necessitated shutting down the station for several days until these could be drained and refilled with new oil. Quick work with sandbags saved the dike at the forebay and prevented a bad washout. The Middle Falls station, on the Battenkill, was also saved by sandbags from the threatened destruction.

Notwithstanding the shutdown of these three generating stations in this territory, only minor interruptions in customers' service were experienced. At Johnsonville the distribution line was washed away and this community was out of service for the day. As soon as the water receded sufficiently, a line crew from Watervliet made temporary connections and restored service.

At Greenwich and Schuylerville street-lighting service was off for one night owing to the flooding of transformers in the Middle Falls station. Transformers were brought from elsewhere on the system and a temporary hook-up was made to give service on these lines.

At the Stuyvesant Falls hydro station, on Kinderhook Creek, the water also reached high mark and for a time threatened to wash out a wing of the dam. A large crew of men was hurriedly assembled from this section and through continued efforts during the day and night erected barricades which prevented a serious washout.

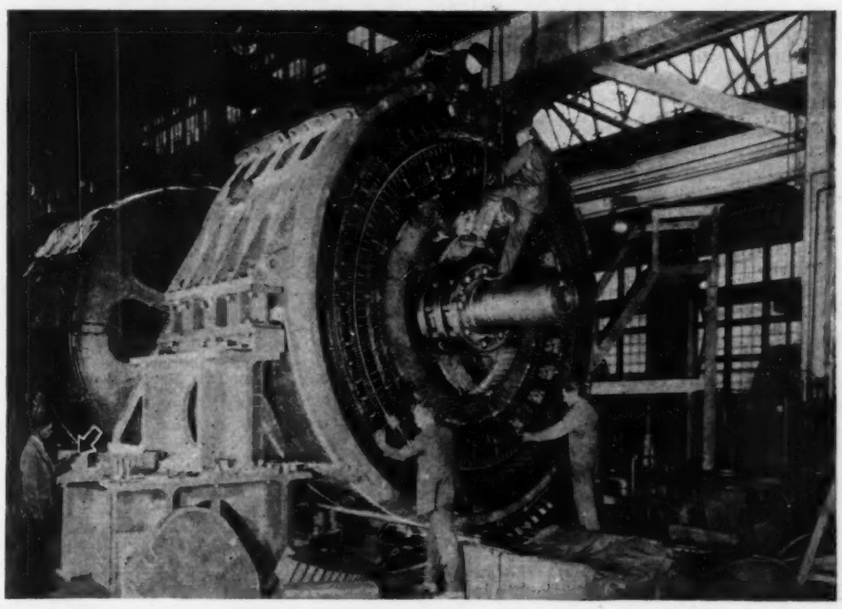
Midwest Power Conference to Meet in February

The third Midwest Power Conference will be held in the Hotel Stevens, Chicago, on Feb. 14-17, 1928. Social and technical aspects of power development and its relation to flood control, embracing Mississippi, Colorado and St. Lawrence River problems, will be discussed. Economics of power stations, particularly steam reheating, high-pressure operation and fuel problems, including a symposium for public utility and manufacturing representatives, will fill three sessions.

A paper on "The General Flood-Control Problem on the Mississippi System," another on "Problems of Storage for Flood Control and for Power Development," a third on the "Irrigation and Power Development Problems on the Colorado River" and a fourth covering "Navigation and Power Development on the St. Lawrence River" are already in preparation. Exact titles covering papers of a more strictly technical nature are not yet determined.

The Midwest Power Conference is

Electrical Equipment on the U. S. S. "Saratoga"



THE U. S. S. *Saratoga*, one of the largest and highest-powered naval vessels in the world, which was launched at Camden, N. J., recently, belongs to the electrically driven group that includes the U. S. S. *Maryland, West Virginia* and *Lexington*. The last named, a sister ship of the *Saratoga*, is now being completed at Quincy, Mass. The *Saratoga*, which will be used as an airplane carrier, will be propelled by electrical machinery developing 180,000 hp., which is more than the combined output of the six electrically driven capital ships now in commission, the *New Mexico, California, Tennessee, Maryland, Colorado* and *West Virginia*.

The propulsion apparatus, which was designed by engineers of the General Electric Company, would supply the electric demands of a large city. The machinery comprises four 35,200-kw. turbo-generator sets which supply current to eight motors. The generators will be operated by steam from sixteen oil-fired boilers. The motors will drive the ship at 33 knots, equivalent to about 38 miles an hour. The eight motors will be connected in pairs to each of the four propeller shafts. Each motor has a capacity of 22,500 hp. and measures 15 ft. in diameter. A total of 45,000 hp. will be delivered to each shaft, which will drive the propeller blades at 317 r.p.m. Subsidiary demands on the *Saratoga* will be supplied by six 750-kw. direct-current turbo-generator sets.

sponsored by the American Institute of Electrical Engineers, American Society of Civil Engineers, American Society of Mechanical Engineers, American Institute of Mining and Metallurgical Engineers, National Electric Light Association, Western Society of Engineers, National Safety Council, American Society of Heating and Ventilating Engineers, and the American Society of Refrigerating Engineers. Major Rufus W. Putnam was recently elected chairman of the conference, Alex D. Bailey vice-chairman, G. E. Pfisterer secretary and K. A. Auty treasurer.

Adjustment of Dispute Over Texas Colorado Sought

At a conference held in Dallas between representatives of the agricultural interests of the upper watershed of the Colorado River and the Syndicate Power Company progress was made toward a satisfactory settlement of the differences between the two contending factions for the use of the water of that stream. It was the expressed belief of Martin J. Insull of Chicago, who attended the conference, that the hydro-electric requirements of the Syndicate Power Company, which is affiliated with the Insull interests, will not prevent the irrigation of large areas of land along the river. The power projects of the Syndicate Power Company involved in the applications already granted by the State Board of Water Engineers will require the expenditure of approximately $25,000,000, it was stated. The company has been granted the use of 1,300,000 acre-feet of water.

The power interests estimated that the economic development might be made upon use of 580,000 acre-feet a year. It was then estimated that enough water might be used above the dams to irrigate at least 80,000 acres and possibly much more.

Association Secretaries Meet at Oklahoma City

Twelve national, regional and state associations were represented at a meeting of the National Association of Utility Secretaries held at Oklahoma City on Dec. 5 to 7. The members of this society are secretaries of utility associations, and the discussions ranged around methods and results in association activities. On the last day of the meeting a tour of the Greater Seminole oil fields was made. E. F. McKay, secretary of the Oklahoma Utilities Association and former secretary of the secretaries' association, was made president of the latter, succeeding John N. Cadby, secretary of the Wisconsin Utilities Association. O. A. Weller, secretary of the Rocky Mountain Division, N.E.L.A., succeeded Mr. McKay as secretary of the secretaries. Next year's conference will be held in New York City on Dec. 3 to 5.

Briefer News

WASHINGTON HOUSEHOLDERS FIGHT BURGLARS WITH FLOODLIGHTING.—Insufficient street lighting in some high-class residential suburban districts of Washington, notably Cleveland Park, and consequent activity by the burglariously inclined have led some residents to adopt floodlighting as a means of protection. Its usefulness in this connection is attracting public attention.

TO REBUILD WALLA WALLA-PENDLETON (WASH.) LINE WITH INCREASED VOLTAGE.—The Pacific Power & Light Company of Walla Walla, Wash., plans rebuilding its Walla Walla River-Pendleton transmission line, raising the voltage from 22,000 to 66,000 and using a new location. The survey has been made. The present line is 20 years old.

MILLION-DOLLAR UTILITY BUILDING FOR FORT WORTH.—Excavation will start promptly for an eighteen-story office building to be erected for the Fort Worth (Tex.) Power & Light Company, and construction operations will commence within two months. The structure will cost about $1,000,000.

LIGHTING EQUIPMENT MANUFACTURERS TO MEET AT CLEVELAND NEXT MONTH.—Jan. 25 to 28 and the Winton Hotel, Cleveland, are the time and place set for the annual meeting of the Artistic Lighting Equipment Association. The 1928 program will be presented, embracing a refixturing and replacement campaign, and complete details concerning the exhibition to be held in Chicago next June will be given.

COST OF NEW HAMILTON (OHIO) PLANT GOES UP.—Hamilton's new municipal electric plant will cost $756,863, according to figures given the City Council by F. H. Froelich, head of the Froelich & Emory Engineering Company of Toledo. The plant, now under construction at the north end of North Third Street, was estimated to cost $650,000, the amount originally provided in a bond issue carried by popular vote.

NEW EMPIRE DISTRICT OFFICE BUILDING OPENED IN JOPLIN, MO.—More than twenty thousand persons visited the new office building of the Empire District Electric Company in Joplin, Mo., on a recent reception day afternoon and evening. The visitors were escorted through the building by employees. Two huge electric signs and ten floodlamps illuminated the exterior. The building cost $200,000.

WEBSTER CITY, IOWA, EXTENDING MUNICIPAL PLANT.—Webster City, Iowa, is engaged in the construction of another power plant to meet increasing demand. The completed work will cost about $55,000 and will include construction of a dam across the Boone River and of a channel from the river above the dam to a natural reservoir. A 1,250-kw. steam turbine and accessories have been purchased at a cost of $33,000.

TO JOIN OWEN AND BOULDER LAKES TO SUPPLY VALMONT (COLO.) PLANT.—Plans are being made by the Public Service Company of Colorado to obtain a 700-acre reservoir for the supply of water to its steam-electric plant at Valmont by the junction of Owen and Boulder Lakes, which will be effected by the erection of several small and one large dam. It is understood that no hydro-electric development is contemplated. The plant is now supplied from Boulder Lake, an artificial reservoir.

NEW UNIT AT SPRINGFIELD, MO., GOES IN AMID CELEBRATION.—Springfield, Mo., boasts of having had an electric power plant since 1885. The most recent addition to its power system is a turbo-generator installed by the Springfield Gas & Electric Company at an expense of $100,000 which brings the rating of the steam plant to 12,500 kw. Distribution lines have been rebuilt and a new switchboard put in. Two hundred business men were recently guests of the company at a banquet in the turbine room to celebrate the opening, where a small generator used in the original plant was on display.

PUBLIC UTILITIES ADVERTISING ASSOCIATION ARRANGES "BETTER COPY" CONTEST.—A "better copy" contest open to all public utility operating companies and covering advertisements released in 1927 and the early part of 1928 has been

Coming Meetings

[A complete directory of electrical associations, with their secretaries, is published in the first issue of each volume. For latest list see the ELECTRICAL WORLD for July 2, page 50.]

American Physical Society—Nashville, Dec. 28-30. H. W. Webb, Columbia University, New York.

American Engineering Council—Washington, D. C., Jan. 9-11. L. W. Wallace, 26 Jackson Place, Washington.

Empire State Gas and Electric Association—Electric Section, Niagara Hotel, Niagara Falls, N. Y., Jan. 12 and 13. C. H. B. Chapin, Grand Central Terminal, New York.

New England Electrical Credit Association—Boston, Jan. 17. C. A. Kane, 176 Federal St., Boston.

National Electrical Manufacturers' Association — Supply Division, Hotel Commodore, New York, Jan. 23-30. S. N. Clarkson, 420 Lexington Ave., New York.

Artistic Lighting Equipment Association—Winton Hotel, Cleveland, Jan. 25-28. G. P. Rogers, 711 Graybar Bldg., New York.

Northwest Association of Electrical Inspectors—Olympic Hotel, Seattle, Jan. 26-28. F. D. Weber, 414 Lumbermen's Building, Portland, Ore.

American Institute of Electrical Engineers — Winter convention, New York, Feb. 13-16. F. L. Hutchinson, 33 West 39th St., New York.

Rocky Mountain Division, N.E.L.A.—Albuquerque, N. M., Feb. 14-16. O. A. Weller, 900 15th St., Denver.

Midwest Power Conference — Hotel Stevens, Chicago, Feb. 14-17. G. E. Pfisterer, 53 West Jackson Blvd., Chicago.

arranged by the Public Utilities Advertising Association. This plan, made public by Donald M. Mackie of the Consumers Power Company, Jackson, Mich., president of the association, contemplates awarding a certificate of merit for the best advertisement and honorary rewards for second and third place in each of three fields—electricity, electric and bus transportation, and gas. Irving M. Tuteur is chairman of the committee in charge.

DISPUTE OVER SERVICE IN CANEY, KAN.—The city of Caney, Kan., has filed suit asking for a permanent injunction against the Caney Electric Company forbidding it to do business within the city limits and asking that its property be removed from the city. Caney's City Council in 1920 passed an ordinance granting a franchise to the company for 50 years. Now the city claims that the franchise is illegal, advancing the theory that 21 years is the limit for a franchise. Caney recently closed a deal with the Coffeyville municipal light plant for electricity and a line is being built from there.

COLONEL CALHOUN'S TIDAL-POWER EXPERIMENTS IN SOUTH CAROLINA.—The Sinking Fund Commission of South Carolina has offered Colonel Patrick Calhoun of Beaufort, S. C., 500 acres of marshland for experiments in the utilization of tides as a source of hydroelectric power. If the experiments prove unsuccessful, the land is to revert to the state by January, 1929, according to Governor John G. Richards. The experiments are to be based on a new type of waterwheel, it is said, and, if the attempt proves successful, Governor Richards anticipates that "this new development will be the greatest industrial addition for South Carolina since the advent of the railroad."

BRYSON PLANT ON THE OTTAWA TO BE TRIPLED.—Announcement has been made by the Ottawa River Power Company that it will triple the capacity of its plant at Bryson, Quebec, probably within two years. Plans have been completed for the purchase and installation of one additional unit immediately. This plant has an ultimate capacity of 75,000 hp. under a 64-ft. head. There is now installed and operating one 25,000-hp. unit, so that the additional unit will bring the plant up to two-thirds of its eventual rating, for which the power house, canal and dam are already ample.

PROTESTS MADE AGAINST PROPOSED DAM ON THE DES MOINES.—The plan of the Central States Electric Company of Cedar Rapids, Iowa, to erect a dam on the Des Moines River at Kalo, near Fort Dodge, where one can be constructed for between $400,000 and $500,000, instead of at the Doliver Park site, where one would cost about $700,000, is opposed by the Fort Dodge, Des Moines & Southern Railway on the ground that the dam there would compel the railroad to rebuild one owned by it, and by the municipality of Boone, which sees a threat to its water supply. The Doliver Park site is also opposed, conservationists being the objectors.

TEXAS TOWN GETS PART OF LIGHTING FREE.—Slaton, Tex., was recently the scene of an unusual agreement between a public utility company and the municipal authorities when the Texas Utilities Company agreed to install 22 modern street lamps free of cost to the city in addition to the 78 already in service. Absence of an extra charge for the additional lamps is equivalent to a reduction of about 30 per cent in the rate.

CONOWINGO PLANT TO HAVE 175,000-LB. SPIDER.—A cast-steel spider weighing 175,000 lb. and measuring 29 ft. across is being machined at the South Philadelphia works of the Westinghouse Electric & Manufacturing Company. It will form part of the rotating element of a 40,000-kva. generator which will be installed at Conowingo, Md. This generator will have a diameter of 37 ft. over all and will run at 81.1 r.p.m.

NORFOLK ADDITION IS FORMALLY OPENED.—A formal opening of the addition to the Virginia Electric & Power Company's generating station on Reeves Avenue, Norfolk, Va., took place with special ceremonies on Dec. 7. The addition cost $5,000,000 and contains a 30,000-kw. turbo-generator. President W. E. Wood made a declaration of the company's faith in the electrical growth of Norfolk, Richmond and tidewater Virginia, over which its interconnected system extends.

DEMONSTRATION OF RURAL ELECTRIC SERVICE TO BE MADE BY TRUCK IN WISCONSIN.—Prof. F. W. Duffee of the Wisconsin College of Agriculture says that electricity can be a great help to many farmers in Wisconsin, particularly to dairy farmers, if they are correctly informed on its costs and proper usage. He says that next year the College of Agriculture will send out demonstration trucks carrying the latest and best electrical equipment ready for operation. This will afford farmers and their wives an opportunity to see for themselves just what electricity can do for them, just what the various operations will cost and how to install and handle equipment to obtain best results.

DOVER-KEENE (N. H.) LINE SELF-SUPPORTING.—The Public Service Company of New Hampshire, which completed an 80-mile transmission line between Dover and Keene, N. H., about a year ago, reports the line as already self-supporting. The Pacific Mills of Dover have recently contracted to take power from this line.

TWO NEBRASKA TOWNS RESIST LURE OF DIESEL ENGINES.—Voters of Sutton, Neb., have refused approval of an ordinance which would have allowed the expenditure of $60,000 in the reconstruction of the city's old direct-current plant into a Diesel engine plant. Less than 45 per cent of the votes cast were for the ordinance, which required 60 per cent. Following this election the City Council of Harvard, 10 miles away, withdrew a municipal-plant ordinance it had prepared and annulled the order for a special election. Business men opposed the project as wasteful, holding that the Central Power Company was making rates as low as any municipal plant could do.

SEATTLE TO CONTINUE TO SELL ELECTRICAL APPLIANCES. — The Seattle (Wash.) Municipal Department will, for the time being at least, continue to sell electrical goods, the Council having reached that decision when it found that its compromise measure to eliminate sales of all equipment requiring less than 500 watts met with the approval neither of merchants who retail electrical equipment nor of spokesmen who said they represented citizens and consumers. The retailers protested against the continued sale of ranges and heaters. J. D. Ross, superintendent of lighting, had offered to eliminate from his retail stock goods requiring less than 660 watts after the Puget Sound Power & Light Company, the city's competitor, announced its intention of discontinuing sales of small electrical goods but continuing to sell ranges and heaters. The 500-kw. offer was then made by the Council as a compromise.

PATERSON AND CRANFORD, N. J., NO LONGER CENTERS OF GENERATION FOR PUBLIC SERVICE COMPANY.—According to the Public Service Electric & Gas Company, two old-time electric generating stations of that utility have been closed down as such, though they continue to be operated, with new equipment, as substations. One of these discontinued central stations is in the populous city of Paterson, which is now served through the new Athenia switching station with energy from the Kearny, Essex and Marion stations transmitted

over a 12-mile line. At Cranford, in the company's central division, power is now received directly from the big metropolitan stations and will be until the completion of the Metuchen switching station, when the energy will be redistributed from there to substations in the vicinity. When the Paterson station was completed in 1896 it ranked as one of the largest in the United States. The Cranford station went into service in 1904.

INSTITUTE SHAPING PROGRAM FOR FEBRUARY MEETING. — Topics tentatively approved for presentation at the winter meeting of the American Institute of Electrical Engineers, to be held in New York on Feb. 13-16, include the operation of interconnected power systems, protective and control systems, automatic substations, arc welding, electrophysics, communication and electrical machinery.

FUNDS SAID TO BE FORTHCOMING FOR OKEFENOKEE PROJECT.—The Spencer-Mill Company of Jacksonville, Fla., has completed financial arrangements for the long-projected hydro-electric development of the Okefenokee Swamp, according to reports from Waycross, Ga. These reports state that the project will cost approximately $12,000,000 and will be financed by New York bankers. The preliminary survey, authorized by the Federal Power Commission, has been made, and it is thought that application for a license will soon be filed. Two dams are proposed, one at the head of the St. Mary's River and the other at the head of the Suwanee River. The two projects would impound approximately 25,000 acres and are intended to supply power for the section in unlimited quantities and a steady water supply for Jacksonville. Inasmuch as the Hebard Cypress Company owns a large part of the Okefenokee Swamp, final action may, however, be affected by its attitude.

CINCINNATI UTILITY MAKES LARGE CONTRACT FOR INDUSTRIAL POWER.—The American Rolling Mill Company, Middletown, Ohio, will in future obtain its electric power from the Union Gas & Electric Company, Cincinnati, and in all probability completely shut down its own generating plant at Middletown. This is the result of one of the largest orders for power ever placed in the Miami Valley, the deal having just been made between George M. Verity, president of the rolling mill company, and H. C. Blackwell, president of the electric company. The mill's yearly demand will be for more than 15,000 kw. The Union Gas & Electric Company and its associated systems supply Cincinnati, Dayton, Hamilton, Middletown, Franklin and Miamisburg, Ohio, and their output is to be increased in 1928. Mr. Blackwell, commenting on the contract, declared that it "shows the increasing confidence and belief of great modern industrial concerns in central-station service, produced efficiently and economically in modern power plants."

Commission Rulings

PRIORITY RIGHTS OF UTILITY GIVING SATISFACTORY SERVICE IN DISPUTED TERRITORY SUSTAINED.—Fort Klamath, Ore., and the territory in the immediate vicinity thereof are in the operating field belonging exclusively to the Wood River Power Company and not subject to lawful invasion by a second utility as long as the territory is adequately served with power and light, according to the decision of the Oregon Public Service Commission. Dispute arose between the Wood River utility and the California-Oregon Power Company concerning prior operating privileges in the territory, and the former filed an application with the commission for an order to restrain the California company from entering the district. Investigation by the commission has brought a judgment in favor of the Wood River Power Company on the grounds that this utility was first in the field and is satisfactorily serving the public. (See ELECTRICAL WORLD for Sept. 17, page 582.)

VERMONT COMMISSION ACTS TO EXPEDITE EMERGENCY CONSTRUCTION. — The Public Service Commission of Vermont, in order to avoid delay in the reconstruction work made necessary by the recent floods in that state, has ruled that during the emergency securities may be issued by public utility companies which have suffered plant damages without a preliminary examination of the expenditures by the commission's experts. The commission adds these conditions: (1) That the money so raised shall be expended solely for plant rehabilitation; (2) that a special account be created to which expenditures for plant rehabilitation shall be charged, with full detail preserved of material and labor employed; (3) that reports of these expenditures be rendered to the commission at regular intervals as required; (4) that the costs of property destroyed, of clearing up and special maintenance, temporary construction, emergency service and all extraordinary items shall be amortized as a deduction from gross income over a term of years to be fixed later, provided that no reserves for this purpose have been created; (5) that these expenditures will be subject to a subsequent audit and review by this commission.

NON-COMPENSATORY RATES FOR AIR HEATING WEIGHED AGAINST CUSTOMERS' THREATENED LOSS IN EQUIPMENT.—A proposed increase in rates for air heating by electricity has been rejected by the Washington Department of Public Works, says *Public Utilities Reports,* and a more moderate increase ordered where it appeared that although the current rates were non-compensatory and discriminatory, patrons had originally been solicited by the utility and had installed equipment for such service at considerable expense. The commission was of the opinion that the loss should be distributed between the utility and consumers. It said in part: "Customers discontinuing such service will suffer a loss due to the fact that they will abandon their electrical air-heating equipment and find it necessary to install some other type of equipment for heating purposes. These losses will vary considerably between customers and will depend primarily upon the difference between the amount realized by the sale of the equipment and the actual value of the equipment at the time it is abandoned, as well as the additional expense that may be incurred in installing other types of heating equipment after the houses have been built over the cost of installation at the time the houses were built. Practically all of the customers have had at least five years or more use of their equipment, which will reduce the present value considerably below the original cost of the equipment."

Recent Court Decisions

INDEMNITY FOR LOSS FROM FIRE ASCRIBED TO DEFECTIVE TRANSFORMER.—To Cain, Hurley and Fleishel, three officials of the Cain-Hurley Lumber Company of East St. Louis, Ill., $120,000 damages was awarded by a jury in the United States Court for the Eastern District of Illinois in a suit against the Illinois Power & Light Corporation because of the destruction by fire of their planing mill and lumber yard at Brooklyn, Ill. It was charged that a defective transformer of the Madison County Light & Power Company (since absorbed by the Illinois Power & Light) caused the fire. The defense maintained that the transformer was not defective and therefore could not have been responsible for the fire, and it is expected that the verdict will be appealed.

ERECTION OF ELEVATED RAILROAD NOT BEING ORDINARY STREET USE, CITY MUST PAY COST OF MOVING POLES AND WIRES.—A suit against New York City resolved in favor of the New York & Queens Electric Light & Power Company by the New York Supreme Court, Appellate Division, hinged on the circumstance that in order for the city to build an elevated railroad it became necessary temporarily to remove and relocate poles, wires and other fixtures of the power company. The city's contractor was obligated, if required, to remove and relocate in a safe and permanent condition the wires, cables and poles that interfered with the erection of the railroad and also to do all temporary work necessary to maintain the regular service of the cables and wires during their removal and relocation, the city to pay the contractor, if the contractor were required to do such work, the actual and necessary cost. The engineer for the city's transit commission did not direct the contractor to do this work, however, but the city made demand upon the power company that it be done by the latter at its sole expense. The power company and the city, acting through the commission, then entered into an agreement whereby the company agreed to remove expeditiously all its wires and other attachments along the route, temporarily maintain them in such a way as not to interfere with the construction of the railroad and eventually to attach the wires to the railroad in such manner as not to interfere with its maintenance and operation. It was further agreed that all such work be done at the cost of the power company, without prejudice to its claims that the city was under legal obligation to pay for the work. The court, in finding for the company, said that in constructing the railroad the city was not acting in any governmental capacity, but was engaged in a proprietary enterprise, and that the erection of the railroad was not an ordinary street use.

News About Men of the Industry

J. E. Hewes Resigns

James E. Hewes, vice-president and general manager of the Eastern New York Utilities Company, which was recently merged with the New York Power & Light Corporation, will resign on Jan. 1 to specialize in the investigation of engineering and operation of public utilities. Mr. Hewes joined the Albany Southern Railroad Company in 1909 in an advisory capacity soon after that company was brought out of receivership. He was appointed vice-president and general manager thirteen years ago and since that time has been the directing head of both the railroad and the gas and electric departments of the company. Five years ago the company took the name of the Eastern New York Utilities Company, Mr. Hewes remaining its active head. Before removing to Albany Mr. Hewes for five years was assistant to the vice-president in charge of operation, H. M. Byllesby & Company, Chicago.

ALFRED ALSAKER, chief engineer of the Delta-Star Electric Company, Chicago, returned from abroad Dec. 14 aboard the Cunard liner *Berengaria* after an extended trip to various European countries.

THOMAS W. HUGHES, superintendent of the Sheridan County Electric Company, Sheridan, Wyo., has been transferred to the position of manager of the Rawlins Electric Light & Fuel Company, Rawlings, Wyo.

THOMAS COCHRAN, a partner in J. P. Morgan & Company, has been elected a director of the General Electric Company, to succeed Dwight W. Morrow, who is now Ambassador to Mexico. Mr. Cochran, who has been a Morgan partner since Jan. 1, 1917, is a director of seventeen other organizations, among which are the Bankers' Trust Company, the Foreign Finance Corporation, the Kennecott Copper Corporation, the Nevada Consolidated Copper Company, the Thompson-Starrett Company, the Fifth Avenue Bank of New York, the Asssociated Dry Goods Corporation and the Alaska Development Corporation.

R. L. SHEPHERD, formerly Southern editor of the ELECTRICAL WORLD, has joined the sales promotion staff of the McGraw-Hill electrical papers, with headquarters in New York. The broad experience of Mr. Shepherd obtained through his editorial activities will be utilized in his new position as a part of the business service rendered ELECTRICAL WORLD advertisers. He affiliated himself with the editorial staff of the ELECTRICAL WORLD in 1922, following a connection with the Public Service Corporation of New Jersey which covered a period of one and one-half years. Mr. Shepherd is a graduate of the Sheffield Scientific School of Yale University and a member of the American Institute of Electrical Engineers, the American Welding Society and other technical associations.

Professor Karapetoff Honored by Franklin Institute

To Prof. Vladimir Karapetoff of the School of Electrical Engineering of Cornell University has been awarded the Elliott Cresson gold medal by the Franklin Institute of the State of Pennsylvania "in consideration of the inventive ability, skill in design and detailed theoretical knowledge of kinematics and electrical engineering displayed in the development of computing devices." This medal will be presented at the annual "Medal Day" meeting of the institute, which will be held May 16, 1928, when all of the medals which shall have been awarded

VLADIMIR KARAPETOFF

during this institute year will be presented to those thus honored.

Though Professor Karapetoff has devoted most of his time to academic work since his arrival in this country twenty-odd years ago, his connection with central-station companies and electrical manufacturing companies during the summer months indicates the success with which he has undertaken practical engineering tasks.

ARTHUR B. LISLE has been elected president of the Central Connecticut Power & Light Company, a consolidation of the East Haddam and Colchester electric light companies and the Essex Light & Power Company. Mr. Lisle is well known in central-station circles, having been associated with the Narragansett Electric Lighting Company of Providence for thirty years, during twenty of which he served as general manager. In the recent acquisition of the Narragansett company by the New England Power Association he was made vice-president of the Narragansett organization. Mr. Lisle is a past-president of the New England Division of the N.E.L.A.

J. C. Hoge Vice-President of Nebraska Utility

J. C. Hoge, formerly general superintendent of the Central Power Company, Grand Island, Neb., has been elected vice-president of the same company in charge of operations. Mr. Hoge was graduated from the University of Nebraska in 1910 with the degree of bachelor of science, electrical engineering. His first work was in the city engineering department at Lincoln, Neb. In 1912 he was chief engineer of the water and light plant and city electrician for Lincoln. In the same year he received the degree of electrical engineer from the University of Nebraska, and in 1913 he opened an office as consulting engineer.

In 1914 he became engineer in charge of construction of the hydro-electric plant on the Loup River at Boelus, Neb., which work was done by the L. E. Myers Construction Company of Chicago. After completion of this work he became chief engineer of the Continental Gas & Electric Company with headquarters at Omaha, and during the war he was connected with the radio school at the university. After the war he formed a connection with the Central Power Company in May, 1920, and he has been with this company in various capacities since that time.

Obituary

RALPH DRAPER SMITH, manager of the Keene district of the Public Service Company of New Hampshire, died suddenly Dec. 9 at Keene. Mr. Smith was 57 years of age and was widely known in New England and central-station circles. He removed to Keene in 1905 from Hoosick Falls, N. Y., to become superintendent of the Keene Gas & Electric Company, and in 1915 he was made treasurer and manager. Upon the acquisition of the Keene company by the Insull group he was made district manager.

CHARLES F. PFISTER, a vice-president and director of the Milwaukee Electric Railway & Light Company, died Nov. 12 at his home in that city. A native of Milwaukee, Mr. Pfister had long been a prominent business leader and philanthropist, who busied himself in the industry of his home city and in its financial institutions and its civic and charitable organizations. As a director of the North American Company for thirty years and as a vice-president and director of the Milwaukee Electric Railway & Light Company since its organization in 1896, he was a pioneer and a dominating factor in the development of Milwaukee's transportation system. As a director of the Wisconsin Gas & Electric Company and the Wisconsin-Michigan Power Company, Mr. Pfister contributed materially to the direction and growth of the associated companies in Wisconsin and upper Michigan.

Financial and Statistical News

Stocks Again Advance Previous Losses Recouped Bond Market Active

POWER and light stocks have again entered the heavy-buying areas of the securities markets. Prices have recovered or are recovering losses incurred in the October and early November selling movement, more or less dispelling the impression that apprehension concerning federal investigation was an important market factor.

During the selling movement referred to utility stocks were the last broad class of stocks to give way to selling pressure. Owing probably, in part at least, to uncertainty as to what might be forthcoming from Washington, they were also slower to recover. It is only since the beginning of the present week that they have fully recovered previous losses, and averages are now at higher levels than ever before, in what has been called a "Christmas market." Advances of several points during the week are recorded by Boston Edison, American Gas & Electric, Pacific Gas & Electric, Philadelphia Electric and others.

Public utility bonds have shown some revival of strength during the week, and accumulation of certain issues has been active. Southwestern Power & Light 6's advanced two points to 108; Central Illinois Public Service 5's are up two points to 103, while one-point gains were made by Ohio Public Service 5's, Public Service of Northern Illinois 5½'s and several other issues.

Although new financing for the eleven months ended November exceeds all previous records by a huge margin, new issues pending will add well over $200,000,000 to the year's total.

Recent Foreign Financing

During the past few weeks several substantial foreign loans have been floated — Canada, Japan and Norway being the countries represented. The Canadian Hydro-Electric Corporation, Limited, issued 6 per cent cumulative first preferred stock, totaling $12,500,000, the price being 97 and accrued dividend. The corporation, a subsidiary of the International Paper Company, is being organized to acquire and hold control, through stock ownership, of the Gatineau Power Company, Gatineau Electric Light Company, Limited, and the St. John River Power Company. This issue was made to provide funds to complete payment for acquisition of shares and payment for indebtedness.

The Shinyetsu Electric Power Company, Limited, made an offering of first mortgage 6½ per cent sinking-fund bonds, a piece of financing involving a total of $7,650,000. These bonds were priced at 93¼ and interest to yield 7.07 per cent. The company owns and operates three hydro-electric plants with a total generating capacity of 57,860 kw. on the Nakatsu River in Japan.

First (closed) and general mortgage 5½ per cent gold bonds were issued by the Vamma Water Power Company at 98 and accrued interest, to yield about 5.65 per cent. This issue involved a total of $5,000,000. The Vamma Water Power Company is a subsidiary of the Hafslund Company, which is the second largest producer of electric power in Norway. These companies own three hydro-electric plants with a total installed capacity of 173,000 hp., the Vamma company's plant (102,000 hp.) being the largest.

Payment of Stock Dividends Examined by Federal Trade Commission

Capitalization of Portion of Accumulated Surplus Is Regarded as Defensible in Certain Cases—Sometimes Merely Tax Evasion

IN VIEW of the wide use of stock dividends by some of the leading public utility companies, utility officials are following with interest the current investigation by the Federal Trade Commission into the situation. Following the Supreme Court's decision of March, 1920, that such dividends are not taxable to the shareholders, a rapid increase has taken place in the total of stock dividends paid. According to the commission's findings over six billion dollars has been paid out in this way, in stock, by 10,245 corporations during the period 1920-1926.

While only a preliminary report has yet been issued by the commission, it may be assumed therefrom that distinction will be drawn between policies of issuing stock dividends merely as a mode of tax evasion and the use of such dividends as a perfectly legitimate means of financing expansion. The report calls attention to significant changes in corporate dividend policy since 1920 thus:

"1. Corporations have apparently distributed in seven years, 1920-1926, much larger proportions of total distributable surplus, and total surplus attributable to the period, than in the seven years 1913 to 1919.

"2. This increase in distribution has been chiefly by way of both absolute and relative increases in stock dividends in the later period as compared with the earlier. While there were considerable absolute increases in cash dividends in the second period, there was practically no relative increase.

"In part these differences are due to the abnormal character of business and financial conditions resulting from the world war; in part they are the results of the tax policies of the federal government."

Questions Advantage to Business

The report finds that this rapid increase in the payment of stock dividends does not seem to be the result of necessity and questions its advantage as a business policy. Contention is made that the reduction of surplus through a stock dividend leaves the stockholder's equity in a corporation precisely where it was as measured by its book value. "Furthermore," says the report, "the stock dividend policy places permanently beyond the reach of shareholders, for purposes of any subsequent distribution in cash or other assets, whatever part of the surplus is capitalized. From the standpoint of the corporation it has been argued that this is an advantage because new capital has in effect been thus permanently obtained without the necessity of selling new securities. But, essentially, this is only an argument for financing capital requirements from earnings and hence is not inseparably or peculiarly related to stock dividends.

Surplus Is Reduced

"The capitalization of surplus automatically reduces the total surplus, surplus per dollar of stock capitalization and surplus per share below that which would be available if the capital stock is split into the same total number of shares. The corporation surplus serves as a reserve fund out of which dividends may be paid when not earned during the current year and against which losses and adjustments (if not too large) may be charged, thus avoiding possible impairment of the capital investment and inability to pay dividends without a readjustment of capital structure, even though such dividends are earned. On the other hand, where no stock dividends are declared shareholders may get a wrong impression of the nature of their property if the surplus has in major part been already embodied in fixed assets. The capitalization of that part of accumulated surplus thereby rendered unavailable for dividends or for reserve funds that may be needed later might be defended, under such circumstances as a desirable correction of capital accounts.

"Had capital stock 'split-ups' been substituted even to a comparatively

limited extent for stock dividends from 1920 to 1926, each shareholder might have possessed as many shares as he held at the end of that period, but each share would have been somewhat better protected, in so far as surplus serves as a protection to shareholders.

"The foregoing statements should not be taken as favoring the creation of an excessive surplus or its indiscriminate investment. Even though it is necessary or desirable for one reason or another to pursue a policy of building up a large surplus from earnings and reinvesting it in the business, it does not follow that it is either necessary or desirable to capitalize that surplus to the extent prevailing in the last few years."

Company Reports

Name of Company	Gross Earnings Twelve Months Ended Oct. 31 1927	1926
Baton Rouge Electric	$1,018,899	$931,654
Blackstone Valley Gas & Electric & subs.	5,902,601	5,424,325
Cape Breton Electric	651,413	605,121
Carolina Power & Light	8,851,646	8,002,806
Columbus Electric & Power	4,168,995	3,633,369
Eastern Texas Electric & subs.	7,017,294	5,457,781
Edison Elec. Illg. of Brockton	1,917,312	1,750,491
El Paso Electric & subs	2,978,369	2,772,724
Galveston-Houston Electric & subs	5,008,541	4,433,839
Lowell Electric Light	1,779,314	1,711,096
No. Texas Electric & subs	2,637,057	2,524,372
Penn-Ohio Edison	1,048,859	1,118,789
Puget Sound Pwr. & Lt. & subs.	14,676,018	13,365,674
Savannah Electric & Power	2,242,135	2,192,101
Sierra Pacific Electric & subs.	1,248,566	1,231,893
Tampa Electric & subs	4,769,282	4,735,968
Virginia Elec. & Pwr. & subs.	12,783,072	11,787,027

Narragansett Company Merger Approved

Another step toward the simplification of the public utility structures in Rhode Island was recently taken in the acceptance by the stockholders of the Narragansett Electric Lighting Company of an offer of the United Electric Power Company for transfer of the assets and properties of the Narragansett company to the power company under terms lately established by the Public Utilities Commission of the state. Under the earlier set-up, the Rhode Island Public Service Company owned the entire capital stock of the United Electric Power Company and also owned all of the stock of the Narragansett Company, which in turn owned over 99.5 per cent of the stock of the Narragansett Electric Lighting Company. The Service company also controlled the United Electric Railways, and the New England Power Association controlled the Service company.

The process of simplification wipes out the Narragansett Electric Lighting Company and the Narragansett Company, and in place of the United Electric Power Company is set up a new corporation called the Narragansett Electric Company, which is the light and power entity of the new structure and directly owned by the Rhode Island Public Service Company. The last-named company continues to own a controlling interest in the United Electric Railways. Ultimately the South County Public Service Company and other subsidiaries of the old Narragansett Electric Lighting Company will become a part of the Narragansett Electric Company. This will leave the Rhode Island Public Service, or holding company, in control of the electric and railway companies, the New England Power Association continuing as the parent company of the group.

Customers Provide Third of Expansion Capital

Stock sales to customers have provided more than one-third of the entire new capital for extension and development of operating subsidiaries of the Public Service Corporation of New Jersey during the past six years, according to President Thomas N. McCarter.

Discussing the progress made in this way, Mr. McCarter said:

"Since 1921, when our popular ownership campaigns were inaugurated, Public Service Corporation of New Jersey has sold a total of 580,932 shares of its preferred stock to 117,144 subscribers, providing $58,093,200 new capital. During the same period $160,642,615 was expended for betterments and additions, of which $105,165,734 was spent in the electric division. On this basis these campaigns provided 36.2 per cent of the total capital expenditures and 55.2 per cent of the electric division expenditures where the greatest development has taken place during the past six years.

"The Public Service Corporation of New Jersey in recent years recorded an unusually rapid increase in the number of individual stockholders," Mr. McCarter added. "Eliminating all duplications, where customers hold either more than one class of preferred or preferred and common stock, the company carried the names of 70,337 individual stockholders on its books as of Nov. 1, 1927. This compares with 2,763 stockholders reported in 1921. The most gratifying development is the large increase in the number of women stockholders, the total being well above 30,000 at the present time, compared with practically none six years ago."

Shortage in Securities Available for Trust and Similar Investment

ADDITIONAL evidence of the shortage of first-grade investment securities for financial and fiduciary purposes was presented last week by J. L. Loomis, president of the Connecticut Mutual Life Insurance Company, before the Association of Life Insurance Presidents. Mr. Loomis showed that 75 per cent of the increase in assets of the life companies, amounting to about $1,500,000,000, will go into city mortgages, farm mortgages, public utility and railroad bonds during 1927. It was pointed out that this does not involve sufficient diversification. He said:

"There are many strong and attractive investment issues, well tested, in other lines of industry that in the past twenty years have become more and more necessary to the public welfare and progress, into which it seems, with wise limitation, we all might have some admission. At least $3,000,000,000 is invested in the basic industry of steel; at least $8,000,000,000 of capital, surplus and profits is invested in the absolutely necessary function of banking and trust company service, to mention but two important fields."

This statement of a lack of suitable investment securities even for insurance companies which are permitted to purchase utility bonds further emphasizes the desirability of making these eligible for trust and savings-bank investment.

With regard to the general shortage existing in available securities, Mr. Loomis said:

"The resources of the life companies during the twenty-two years ending with 1926, as shown by Mr. Ecker's paper of last year, became five times as great, while the national wealth became less than three and one-half times as great. No small proportion of this increase in national wealth has been in lines of industry to which life insurance funds, by limitation of statute or strongly intrenched investment views, have made but small if any direct contribution. By the same token rapidly growing resources of savings banks, trust funds in the hands of trust companies, building and loan funds, have almost entirely gone into the same restricted channels—further restricted by the annual retirement of a billion dollars of the government debt."

New Issues, $107,520,000

Electric light and power financing during the week ended Dec. 15 was unusually heavy, five companies having issued new securities to the amount of $107,520,000. The largest individual loan was floated by the Philadelphia Company in the form of 5 per cent secured gold bonds, a piece of financing involving a total of $60,000,000. These bonds, dated Dec. 1, 1927, and maturing Dec. 1, 1967, were priced at 98 and accrued interest to yield 5.11 per cent. The company will devote the proceeds of these bonds to the retirement of all its present outstanding mortgage indebtedness, the purchase of additional Duquesne Light Company stock, the acquisition of an interest in the Kentucky-West Virginia Gas Company and to other corporate purposes.

First and refunding mortgage gold bonds of the Duke Power Company were offered to the amount of $40,000,000 at 98 and accrued interest. This issue, bearing interest at the rate of 4½ per cent, is another example of the facility with which utility companies are able

to borrow money at low rates. These bonds, dated Dec. 1, 1927, and maturing Dec. 1, 1967, are secured by a direct lien on all the fixed electrical properties acquired or being acquired by the Duke Power Company. Proceeds will be used to reimburse the company for expenditures made in connection with additions and improvements to plant and property, to retire floating indebtedness incurred in connection therewith and for other corporate purposes.

During the week under review the Central Public Service Corporation issued series A 6 per cent collateral trust gold bonds to the amount of $4,500,000, the price being 97½ and accrued interest, to yield about 6.30 per cent. Proceeds will be used for the acquisition of properties, to retire indebtedness and for other corporate purposes.

First and general mortgage gold bonds of the Central Maine Power Company to the amount of $2,000,000 were offered at 98 and interest, yielding about 4.62 per cent.

The Binghamton Light, Heat & Power Company issued 10,000 shares of six-dollar cumulative preferred stock at $102 and accrued dividend to yield 5.88 per cent.

Canadian Hydro Installation, 4,883,000 Hp.

Figures Just Given Out by the Water-Power Branch Put Capitalization at $900,000,000, Highest for Any Single Industry

ACCORDING to a report just issued by the Water Power Branch of the Canadian Department of the Interior, the total installation of water-power plants in the Dominion will be 4,883,000 hp. by the end of the present year, and if the present rate of increase continues, will easily have passed the 5,000,000-hp. mark by the end of 1928. As indicating the rapid growth of hydro-electric development in the Dominion, it is pointed out that in 1900 the total installation amounted to only 170,000 hp. During the subsequent decade that development grew to 975,000 hp.; at the close of 1914 it was 1,946,000 hp., and at the end of 1920 it had increased to 2,508,000 hp.

As further evidence of Canada's possible installation, J. T. Johnston, director of the Water Power Branch, says in the report: "It is not correct to substract the total installation at Nov. 1 (4,883,000 hp.) from the totals of available power to determine what power remains undeveloped, as investigation has shown that throughout the Dominion the installations at developed sites exceed the estimates of ordinary six-month power at such sites by about 30 per cent. On this basis the total recorded resources of Canada would warrant the installation of about 43,000,000 hp. In other words, the present turbine installation represents slightly more than 11 per cent of the total resources."

The total capital invested in the water-power industry in Canada at this date is estimated to be $900,000,000, or more than that for any other single manufacturing industry. The corresponding figure in 1910 was $121,000,000, so that the increase in seventeen years is more than 600 per cent. This total includes the cost of the primary and auxiliary power plants, transmission and distribution systems with land, machinery and equipment. Applied to the existing installation, it amounts to an average of $183 per horsepower, and, in view of the steady earning power shown by the industry even in times of industrial difficulties

Stock Quotations of Electric Light and Power and Manufacturing Companies

(Prices on New York stock market unless otherwise noted. Unless otherwise noted the par, stated, or preference value of stock is $100.)

Companies	Bid Price Tuesday Dec. 13	Low 1927	High 1927
ABITIBI PWR. & PAPER, 4% com.—no par	138½	83	143
Ala. Pwr., $7 com. pf.—no par	113	107	112½
Allis-Chalmers Mfg., 6% com.	115	88	118½
Aluminum Co. of Amer., com.	133½	67½	145
Aluminum Co. of Amer., 6% pf.	106½	101½	106½
Amer. & Foreign Pwr., 7% pf.—no par	108½	86½	108½
Amer. & Foreign Pwr., com.—no par	29½	18½	30½
Amer. Bosch Magneto, com.—no par	22	13	26½
Amer. Brown Boveri Elec.†	13½	5½	39½
Amer. Brown Boveri Elec., pf. $7	59	40	98
Amer. Gas & Elec., 6% pf.—no par	106	95½	105
Amer. Gas & Elec., com. †—no par	119½	68½	125
Amer. Lt. & Trac., 6% pf.	115	112	126
Amer. Lt. & Trac., new com.	k175	164½	186
Amer. Pwr. & Lt., 6% pf.	106	97½	105
Amer. Pwr. & Lt., com. †—no par	63½	54	73½
Amer. Pub. Serv., 7% pf.	a 99	....	....
Amer. Pub. Serv., com. †	k 70	65	75
Amer. Pub. Utilities, 7% pfc. pf.	a 89	73	90
Amer. Pub. Utilities, 7% pr. pf.	95	88	96
Amer. Pub. Utilities, com.	k 60	65	70
Amer. States Sec., A	4½	2½	4½
Amer. States Sec., B	4½	2½	4½
Amer. Superpwr., 6% pfc pf.—25	k 29½	26½	29½
Amer. Superpwr., 6% 1st pf.	l 99½	....	....
Amer. Superpwr., Class A†—no par	39½	27½	41½
Amer. Superpwr., Class B†—no par	40	28½	43½
Amer. Wtr. Wks. & Elec., 6% pf.	k102½	99½	103½
Amer. W.W. & E., com. new—no par	61½	46½	72½
Anaconda Copper cap. $3	53½	41½	53½
Appalachian Electric Pwr., 7% pf.	101½	100	108
Arkansas Pwr. & Lt. 7% pf.	107	97½	108
Assoc. Gas & Elec., $3.50—50	52	50	54
Assoc. Gas & Elec., pf.—$6—no par	96	85	96
Assoc. G. & E., Class A, 10—no par	50½	....	....
BABCOCK & WILCOX, 7% com.	125	113	132
Binghamton L., H. & P., $6 pf.	102½	93	102
Birmingham Elec., pf.—$7—no par	110	105	110
Blackstone Valley G. & E., 6% pf.	k107	103	105
Blackstone Valley Gas & Elec., 10% com.—50	k128	98	153
Blaw-Knox, com.†	d100	70	105
Brazilian Trac., Lt. & Pwr., com.†	f217	....	....
Broad River Pwr., 7% pf.	104	97	104½
Brooklyn Edison, 8% com.	191½	148½	203½
Buffalo, Niagara & East. Pwr., $1.60 pf.—25	l 26	....	....
Buffalo, Niagara & East. Pwr. com. $1—no par	l 31½	....	....
CALIFORNIA ELEC. GENERATING, 6% pf.	k98	96	99½
California Ry. & Pwr., 7% pf.	135	125	150
Carolina Pwr. & Lt., pf.—$7—no par	d109½	....	....
Central & S. W. Util., $7 pf.—no par	a99½	92½	99
Central & S. W. Util., pr. in. $7 pf.—no par	a104½	98½	104½
Central Ark. Ry. & Lt., 7% pf.	104½	100	104
Central Ill. Pub. Serv., $6 pf.	a 95½	85½	95½
Central Ind. Pwr., 7% pf.	a 94½	85½	95½
Central Maine Power, 6% pf.	95	....	....
Central Maine Power, 7%	106	102	106
Central Pwr. & Lt., 7% pf.	103½	100½	103
Central States Elec., 7% pf.	100½	92½	102
Central States Elec., com.†	28½	17½	30½
Century Elec., 6% com.	b137	114	162
Chicago Fuse Mfg., com.—$2.50 no par	m31	30	35½
Cincinnati Gas & Elec., 5% com.	g101½	96½	101½
Cities Service, $6 pf.—no par, ex. div.	l 94½	87	94½
Cities Service, pf. B—no par, ex. div.	l 8½	8	8½
Cities Service, pf. BB—no par, ex. div.	l 88½	80½	86
Cities Service, com.—20, ex. div.	l 52½	40½	58½
Cities Service, Bks. Shrs.—10, ex. div.	l 26	22½	27
Cities Service Pwr. & Lt., 7% pf.	106	100½	106½
Cities Service Pwr. & Lt., 6% pf.	95	90	95½
Clarion River Pwr., 8% pf.	95	....	....
Cleveland Elec. Illg., 6% pf.	112	108	112
Cleveland Elec. Illg., 10% com.	330	285	340
Columbia Gas & Elec., 6% pf.	107½	99½	108½
Columbia G. & E. com. $5—no par	92½	82½	98½
Columbus Elec. & Pwr., $2 com.—no par	67	....	....
Columbus Elec. & Pwr., 7% pf.	108	....	....
Columbus Ry., Pwr. & Lt., 6% 1st pf.	107	98½	106
Columbus Ry., Pwr. & Lt., 6% pf. B	104	96	104
Columbus Ry., P. & L. com.—no par	k105	75	105
Commonwealth Edison, 8% com.	168½	138	173
Commonwealth Pwr., 6% pf.	103½	91½	103½
Commonw'th Pwr., $2, com.—no par	66½	48½	78½
Conn. Lt. & Pwr., 8% pf.	118	119	123
Conn. Lt. & Pwr., 7% pf.	112	112	118
Cons. Gas of N. Y., pf.	102	93	102
Cons. Gas of N. Y., com. $5—no par	118½	94	121½
Cons. Gas, Elec. Lt. & Pwr. of Balti., 6% pf.	e111½	111	111½
Cons. Gas, Elec. Lt. & Pwr. of Balti., 6½% pf.	e114	110½	114½
Cons. Gas, Elec. Lt. & Pwr. of Balti., 7% pf.	e115½	112½	117
Cons. Gas, Elec. Lt. & Pwr. of Balti., 8% pf.	e129½	127	130½
Cons. Gas, Elec. Lt. & Pwr. of Balti., com. $3.00—no par	e 67½	51	71
Consolidated Pwr. & Lt., 7% pf.	105	100	106
Consumers Pwr., 6% pf.	105	100	102
Consumers Pwr., 6.6% pf.	106½	103	105½
Continental Gas & Elec., 8% pfc. pf.	108	103	106½
Continental Gas & Elec., 7% pr. pf.	106	100	103
Conti. G. & E. com., $4.40—no par	k220	210	225
Crocker Wheeler, com.†	23	23	38
Crocker Wheeler, 7% pf.	78	78	88
DALLAS PWR. & LT., 7% pf.	110	107	110½
Dayton Pwr. & Lt., 6% pf.	108	101	109
Detroit Edison, 8% com.	168	133½	168
Dubilier Condenser, com.—no par	2½	2	5½
Duke Pwr., cap.	125	115	130
Duquesne Lt., 7% pf.	116	114½	117½
EASTERN NEW YORK UTIL., $7 pf.	k110	102	104½
Eastern New York Util. com.	k 65	70	75
Eastern States Pwr., $7, com.	12½	9	14
Eastern States Pwr., pf.	97½	90	95
East. Tex. Elec., 7% pf.	107	106	108
Edison Elec. of Boston, $12 com.	d257	217	267
El Paso Elec., 7% pf.	108	105	107½
Elec. Bond & Share, 6% pf.	l109½	105½	110½
Elec. Bd. & Sh. Sec., com. $1—no par	l 74½	67½	80½
Electric Household Util.†	a 13	11	15½
Elec. Investors, 6% pf.—no par	99	92	97
Elec. Investors, com.†—no par	42½	32½	44½
Elec. Pwr. & Lt., ctfs. pf.	107	96	109
Elec. Pwr. & Lt., ctfs., 40% pd.	k119½	103½	120
Elec. Pwr. & Lt., ctfs., com.—no par	28½	16½	29½
Elec. Refrig. cap.†	8½	5½	37½
Elec. Ry. Securities, com.—no par	6½	5½	8
Elec. St. Battery com. $5.25—no par	76½	63½	81
Elmira Wtr., Lt. & R.R., 7% pf.	k104½	99	101½
Empire Pwr., pfc.†	33	26	39
Engr. Pub. Serv., $7 pf.—no par	107½	93½	105½
Engr. Pub. Serv., com.—no par	35½	21½	39½
Eureka Vacuum Cleaner, com. $4—no par	m 77½	50	77½
FAIRBANKS MORSE, 7% pf.	k107	107½	112
F.-M., com.—$3—no par	k 34	30½	43½
Federal Lt. & Trac., com. $1.40	44	37½	47
Federal Lt. & Trac., $6 pf.—no par	k 98½	91½	100
Florida Pwr. & Lt., 7% pf.	107	102½	107
Ft. Worth Pwr. & Lt., 7% pf.	l111	....	....
GALVESTON-HOUSTON ELEC. 6% pf.	70	68	72
Galveston-Houston Elec., com.	33	26	32
General Cable, Cla	56	55½	60
Gen. Elec. $3 com.—no par	134½	81	146½
Gen. Elec., special—6%	11½	11	11½
Gen. Gas & Elec. (Del.) com A $1.50—no par	35½	34	47½
Gen. G. & E. (Del.) pf. A $8—no par	k124	113½	123½
Gen. G. & E. (Del.) pf. A $7—no par	k108	100	110½
Gen. G. & E. (Del.) pf. B $7	k105	96	105½
Gen. Pub. Serv., $7 cum. pf., no par	k110	102	106
Gen. Pub. Serv., com., no par	15½	11½	18
Ga. Ry. & Pwr., 8% pf.	k125	119	125
Ga. Ry. & Pwr., 7% pf.	k113½	106	110
Gt. Western Pwr., 7% pf.	h104	....	....
IDAHO PWR., 7% pf.	108	103	109
Ill. No. Utilities, 6% pf.	k 96	88	97
Ill. Pwr. & Lt., 7% pf.	103	99	101½
Ingersoll Rand 6% pf.	k114	106½	120
Int. Combus. Engr., com. $2—no par	54	40½	64
Int. Combustion Engr., 7% pf.	k103½	101	103½
Int. Util., Class A—$3.50—no par.	50½	28	53
Int. Utilities, Class B—no par.	10½	3	11½
Interstate Pwr., pf.—$7—no par.	98	93	98
Interstate Pub. Serv., 7% pf.	102	98	103
Iowa Ry. & Lt., 7% pf.	k 98½	97	99
JERSEY CENTRAL PWR. & LT. CO., 7% pf.	107	97½	105
Johns-Manville, com.†—no par	125½	55½	126½

Stock Exchange: aChicago; bSt. Louis; cPhiladelphia; dBoston; eBaltimore; fMontreal; gCincinnati; hSan Francisco; iPittsburgh; jWashington. kBid price Saturday, Dec. 10. lBid price Wednesday, Dec. 14. mLatest quotations available. †Dividend rate variable.

Stock Quotations of Electric Light and Power and Manufacturing Companies (Continued)

(Prices on New York stock market unless otherwise noted. Unless otherwise noted the par, stated, or preference value of stock is $100.)

Companies	Bid Price Tuesday Dec. 13	Low 1927	High 1927
KANSAS CITY PWR. & LT. pf. $7	116¼	112	116¼
Kansas Gas & Elec., 7% pf.	*l*108¼	....	....
Kentucky Hydro-Elec., 7% pf.	*a*103¼	94¼	104
Kentucky Sec., 6% pf.	86	83	87
Kentucky Sec., 5% com.	115	110	115
Kentucky Utilities, 6% pf.	*k*100	95	101
LACLEDGE GAS LT., 12% com.	*k*208	173¼	267½
Lehigh Pwr. Sec., com.—no par.	19¾	15	22
Long Island Ltg., 7% pf.	112¾	107½	114
Long Island Ltg., com.†—no par.	169	139	180
Los Angeles Gas & Elec., 6% pf.	104	98	104½
Louisville Gas & Elec., cl. A. $1.75	26¼	23¼	27¼
MAN. ELEC. SUPPLY, cap. $5—no par	55½	43	132
Manila Elec., com.†—no par.	*k* 46¼	40	60
Maytag Mfg., com. .50—no par.	31	23¼	34½
Memphis P. & L., pf.—$7—no par.	*k*109¼	107	109
Metropolitan Ed., pf.—$6—no par.	106	93	100
Metropolitan Ed., pf.—$7—no par.	109	104	108
Metropolitan Ed., com. $5—no par.	*k* 70	60	72
Middle West Utilities, 7% pf.	*a*118¼	110¾	119
Middle West Util., 8% pr. lien	*a*125¼	117½	127
Middle West Util., com. $6—no par	*a*123	108	125
Midland Utilities, pr. ln. 6% pf.	*a*105	97½	107½
Midland Utilities, 7% pf. A	*a*101	96¾	103½
Milwaukee Elec. Ry. & Lt., 7% pf.	*k*102	100	103
Milwaukee Elec. Ry. & Lt., 6% pf.	*k* 99	98	101¼
Minn. Pwr. & Lt., 7% pf.	*k*108¼	....	....
Miss. River Pwr., 6% pf.	106	94	104½
Miss. River Pwr., 3% com.	62	....	....
Mohawk Hudson Pwr., 1st pf.—$7—no par.	106	100	109
Mohawk Hudson Pwr., 2d pf.—$7—no par.	114	98	112
Mohawk Hudson Pwr., com.—no par	30½	20½	32½
Montana Pwr., 5% com.	102½	81¼	109½
Montreal Pwr., 7% com.	*f* 90	....	....
Mountain States Pwr., 7% pf.	101	99	102
Mountain States Pwr., com.†	18	....	....
NASSAU & SUFFOLK LTG., 7% pf.	110	98	110
National Carbon, 8% pf.	*m*137	130¼	139½
National Elec. Pwr., A†	*a* 26¾	22	28¾
National Lt., Ht. & Pwr., com.	*k* 24	....	....
National, Light, Ht. & Pwr., 5% pf.	*k* 70	....	....
National Pwr. & Lt., pf.—$7—no par	109	101	110
National Pwr. & Lt., com.†—no par.	23¾	19¼	26¾
National Pub. Serv., 7% pf.	100½	93	100
National Pub. Serv., 7% ptc., pf.	114	108	115
National Pub. Serv., A com. $1.60—no par.	23¼	18¼	24
National Pub. Serv., B com.—no par	27½	14	30
Nebraska Pwr., 7% pf.	*l*110	....	....
Nevada-Calif. Elec., com.	*k* 35	25	36½
New Brunswick Pwr., 4% pf.	*k* 60	....	....
New Eng. Pub. Serv., pr. ln. pf. $7.	*k*101	98½	102
New Eng. Pub. Serv., pf. $7	*k* 98	95	99
New Orleans Pub. Serv.—7% pf.	108½	103	105½
N. Y. & Queens Elec. Lt. & Pwr., 5% pf.	95	91	97
N. Y. Central Elec., 7% pf.	*k*102½	101	104
New York Power & Light, 6% pf. no par	102	....	....
New York Power & Light, 7% pf.	114	....	....
Newport News & Hampton Ry., Gas & Elec., 5% com.	*k*109	....	....
Newport News & Hampton Ry., Gas & Elec., 7% pf.	*k*109	....	....
Niagara Falls Pwr., 7% pf.—25.	*k*28¾	27¼	29¾
Niagara, Lock & Ont. Pwr., 7% pf.	*k*111	110½	113
No. Amer., 6% pf.—50.	*k* 53¾	50	55
No. Amer., com.—10.	60	45¾	64½
No. Amer. Edison, $6 pf.—no par.	*k*103½	96½	105
No. Caro. Pub. Serv., pf.—$7—no par	101	93	102½
Northeastern Pwr., com.	20½	14¼	25
No. N. Y. Utilities, 7% pf.	107	103	109
No. Ohio Pwr., com.—no par.	17¼	9½	18¼
No. Ont. Lt. & Pwr., 6% pf.	*k* 94	84	95
No. Ont. Lt. & Pwr., 4% com.	*k* 72	73	78
No. States Pwr. (Del.), 7% pf.	109	101	109
No. States Pwr. (Del.), 8% com.	131	109¾	133
No. Texas Elec., 6% pf.	*k* 45	65	70
No. Texas Elec., com.	33	27	36
OHIO BRASS, com. B $4—no par.	105	74	109½
Ohio Brass, 6% pf.	*k*106½	106½	106½
Ohio Pwr., 6% pf.	103¾	96	104
Ohio Pub. Serv., $6 pf.	*k*101	95	96¼
Ohio Pub. Serv., 7% pf.	110	103	109
Ohio River Edison, 7% pf.	108½	103	109½
Oklahoma Gas & Elec., 7% pf.	108	....	....
PACIFIC Gas & ELEC., 6% pf.	26½	24¼	27½
Pacific Gas & Elec., 8% new com.	46¾	31	46¾
Pacific Pwr. & Lt., 7% pf.	*l*107	....	....
Penn Cent. Lt. & Pwr., $5 pf.—no par.	*c* 79	75¼	80
Penn-Ohio Edison, 6% pf. no par.	*k* 90	78	91
Penn-Ohio Edison, 7% pf.	*k*107	97½	104
Penn-Ohio Elec., 7% pf.	*m*102	99	103
Penn-Ohio Pwr. & Lt., 7% pf.	108	99	110
Penn Pwr. & Lt.—$7—no par.	*l*109½	....	....
Penn Wtr. & Pwr., 8% com., new	*c* 68¾	47½	73¼
Phila. Co., 5% pf.—50.	*k* 46¾	40	47
Phila. Co., 6% pf.—50.	52½	50	53½
Phila. Co., com.—50.	142½	85¼	142½
Phila. Elec., 8% com.—25.	*c* 56¾	46½	58½
Portland Elec. Pwr., 7% pf.	101½	97½	103
Portland Elec. Pwr., 6% pf.	85	78	84
Portland Elec. Pwr., 6% 2d pf.	73	55	70
Portland Elec. Pwr., com.	33	22	30
Potomac Elec. Power, pf.	*m*111½	....	....
Pwr. Sec., pf.—no par.	*k* 50	28	57
Pwr. Sec., com.—no par.	*k* 12	5	15
Public Serv. of Colorado, 7% pf., ex. div.	*l*104	99	103
Pub. Serv. of N. J., 6% pf.	103¾	98½	105
Pub. Serv. of N. J., 8% pf.	*k*133	125	135½
Pub. Serv. of N. J., $2 com.—no par	42½	32	46¾
Pub. Serv. of No. Ill., 6% pf.	*a*112	101½	112
Pub. Serv. of No. Ill., 7% pf.	*a*120½	112½	120½
P. S. of No. Ill., com. $8—no par.	*a*158	140½	161½
Pub. Serv. of No. Ill., $8 com.	*a*159	132	161½
Pub. Serv. of Okla., 7% pr. ln.	*k*103	90	103
Pub. Serv. Elec. & Gas, 6% pf.	110	102	110½
Puget Sound Pwr. & Lt., 7% pf.	108	105	109
Puget Sound Pwr. & Lt., $6 pf.—no par.	90	....	....
Puget Sound Pwr. & Lt., com.	35½	28	38¾
RADIO COPR. OF AMER., $3.50 pf.—50.	55½	49	57
Radio Corp. of Amer., com.—no par.	88	41¼	101
Rhode Island Public Service, pf. $2—no par.	30½	28¾	30½
Rochester Gas & Elec. 6% pf. D.	*k*105	101	103½
Rochester Gas & Elec., 7% pf. B.	105	105	107
Rochester Gas & Elec., 6% pf. C.	105	101½	103½
SAN JOAQUIN Lt. & Pwr., 7% pr. pf.	*k*111	105	112½
St. Joseph Ry., L., H. & P., 5% pf.	*k* 75	70	75
Servel Corp.	18cts	10cts	10¼
Sierra Pacific Elec., 2% com.	*k* 27¼	24¼	31¼
Sioux City Gas & Elec., 7% pf.	106½	99	105½
Southeastern Pwr. & Lt., pf.—$7—no par.	*l*109½	....	....
Southeastern Pwr. & Lt., ptc. pf.	*l* 70	....	....
Southeastern Pwr. & Lt., com.—no par.	43½	29¾	46
So. Calif. Edison, 8% pf.	*k* 40	36½	43
So. Calif. Edison, 7% pf.	*k* 28½	27¼	28¾
So. Calif. Edison, 6% pf.	*k* 25¼	24¼	27
So. Calif. Edison, 8% com.	41¼	31¾	42
Southern Cities Utilities, 7% pf.	*k* 75	67	90½
Southern Cities Utilities, com. $4.	*k* 32½	23¼	42¾
Southwestern Lt. & Pwr., A $3.	63	60	65
Southwestern Lt. & Pwr., B	63	60	65
Southwestern Lt. & Pwr., com.	88	83	91½
Southwestern Pwr. & Lt., 7% pf.	111¼	104	115
Springfield (Mo.) Ry. & Lt., 7% pf.	103	95	105
Standard Gas & Elec., 8% pf.	65¼	67¼	66½
Standard Gas & Elec., 7% pr. pf.	111	104¾	113¾
Standard G. & E., com. $3.50—rts.	59¾	54	65¾
Standard Power & Light, com.	31	22	32
Standard Pwr. & Lt., 7% pf.	103	98¼	103
Staten Island Edison, pf.—$6—no par.	100	99	103½
Superheater, $6 com.—no par.	168	170	185
Syracuse Lighting, 7% pf.	*k*110	103	111
Syracuse Lighting, 8% pf.	*k*117½	....	....
TAMPA ELEC., com. $2	63	....	....
Tenn. Elec. Pwr., 6% pf.	102	92	102
Tenn. Elec. Pwr., 7% pf.	109½	103	109
Terre Haute, Ind. & East. Trac., 5% pf.	*k* 26	20	30
Terre Haute, Ind. & East. Trac., com.	*k* 1	1	3
Tex. Pwr. & Lt., 7% pf.	*l*113	....	....
Tide Water Pwr., 8% pf.	110¼	105	111
Timken Roller Bear., com.—$4 no par.	134½	78	142½
Toledo Edison, 7% pf., ex. div.	*l*109	102	107
Toledo Edison, 6% pf.	*k*100	95	97
Toledo Edison, 6% com.	*k*100½	93	103
Tri-City Ry. & Lt., 6% pf.	*k* 96½	96	99
UNITED GAS & ELEC., 7% pf.	102	98	103
United Gas & Elec. (N. J.), 5% pf.	74	70	75
United Gas Impr., 8% com.—50.	*c*114¾	89¼	118½
United Lt. & Pwr., pf.—$4—no par.	*k* 53	49	55
United Lt. & Pwr., pf.—$6.50—no par.	95½	87	97¾
United L. & P., com. A .48—no par.	13¾	12¼	15½
United L. & P., com. B .48—no par.	*k* 19	16	21
Utah Pwr. & Lt., 7% pf.	*l*109	....	....
Utica Gas & Elec., 7% pf.	106	105	106½
Utica Gas & Elec., 8% com.	*k*200	....	....
Utilities Pwr. & Lt., 7% pf.	98	93	100
Utilities Pwr. & Lt., com. A $2.	29¼	27	34
Utilities Pwr. & Lt., com. B $1—no par.	21	13¼	23¾
VERMONT HYDRO-ELEC., 7% pf.	*k* 96	95	100
Virginia Elec. & Pwr., 7% pf.	*k*109	105	110
WAGNER ELEC., 7% pf.	*b* 92½	68	90
Wagner Elec., com.—no par.	*b* 31¾	18½	30¾
Washington Ry. & Elec., 5% com., ex. div.	456	180	470
Washington Ry. & Elec., 5% pf., ex. div.	100	....	....
Washington Wtr. Pwr., 8% com.	*k*167	136	182
West Penn Elec., 7% pf.	111¼	102	112½
West Penn Elec., Cl. A $7.	*k*108½	97½	111
West Penn Pwr., 7% pf.	117	111	118
West Penn Pwr., 6% pf.	109½	100½	109¾
West Virginia Lt., Ht. & Pwr., 7% pf.	*k* 95	94	100
Western Pwr., 7% pf.	*k*102	98	101¼
Western States Gas & Elec., 7% pf.	104	96	105
Western States Gas & Elec., com.	38	....	....
Westinghouse Elec. & Mfg., 8% com.—50.	91½	67¾	94½
Weston Elec. Instrument, Cl. A $2—no par.	*k* 31½	30	34½
Weston Elec. Instrument, com.—no par.	*k* 14½	11	18¾
Wheeling Elec., 6% pf.	*k*103	95	104
Worthington Pump, 7% pf. A.	48¾	44	61½
Worthington Pump, 6% B.	43¾	37	54½
Worthington Pump, com.	28¾	20½	46
YALE & TOWNE com. $5—25, ex. div.	*k* 73½	70½	84½

Stock Exchange: *c*Chicago; *b*St. Louis; *e*Philadelphia; *d*Boston; *e*Baltimore; *f*Montreal; *g*Cincinnati; *h*San Francisco; *i*Pittsburgh; *j*Washington. *k*Bid price Saturday, Dec. 10. *l*Bid price Wednesday, Dec. 14. *m*Latest quotations available. †Dividend rate variable.

and depression, it would appear that this capitalization is reasonable and one which the industry is well able to carry.

Two of Canada's rapidly expanding industries—pulp and paper and mining—are becoming tremendous users of hydro-electric energy. The pulp and paper mills, it is now estimated, have a total hydraulic installation in connection with the mills themselves of 526,731 hp., while the additional hydro-electric energy purchased by this industry from central electric stations is estimated at above 831,000 hp., making a total utilization of 1,358,052 hp.

Quebec's total of 2,165,443 hp. is divided into 1,796,692 hp. developed in central electric stations, 242,044 hp. in pulp and paper mills, and the remaining 126,707 hp. in other industries. Of Ontario's total of 1,827,088 hp., central electric stations develop 1,544,766 hp., the pulp and paper mills 174,548 hp. and other industries 107,774 hp.

HYDRO-ELECTRIC INSTALLATIONS IN CANADIAN PROVINCES, AS OF NOV. 1, 1927

	Horsepower
Ontario	1,827,088
Quebec	2,165,443
British Columbia	473,062
Manitoba	255,125
Nova Scotia	65,702
New Brunswick	47,231
Alberta	34,107
Yukon and Northwest Territories	13,199
Prince Edward Island	2,274
Saskatchewan	35
Total	4,883,266

CONSOLIDATED OF BALTIMORE PAYS INITIAL DIVIDEND.—The Consolidated Gas, Electric Light & Power Company of Baltimore has declared an initial quarterly dividend of $1.37½ on new series 5½ per cent preferred stock, payable Jan. 3 to stock of record Dec. 15.

GENERAL ELECTRIC EMPLOYEES SUBSTANTIAL STOCKHOLDERS. — Twenty seven thousand, or 42 per cent, of the employees of the General Electric Company in its service for six months or more are holders of about $80,000,000 worth (face value) of G. E. Employees' Securities Corporation bonds, an average of approximately $1,000 per person, according to a statement made public by J. R. Lovejoy, president of the corporation and vice-president of the General Electric Company. These bonds pay 6 per cent interest, but so long as the original holder remains in the employ of the General Electric Company an additional 2 per cent is paid by that company. In making this announcement Mr. Lovejoy stated that a new offering of the bonds to employees would be made. These bonds, as with previous issues, may be bought on the installment plan with deduction from wages.

Seasonal Decline in General Production

All Industrial Groups, Except Rubber, Register November Operations Under October—General Rate of Activity Slightly Over Last Year

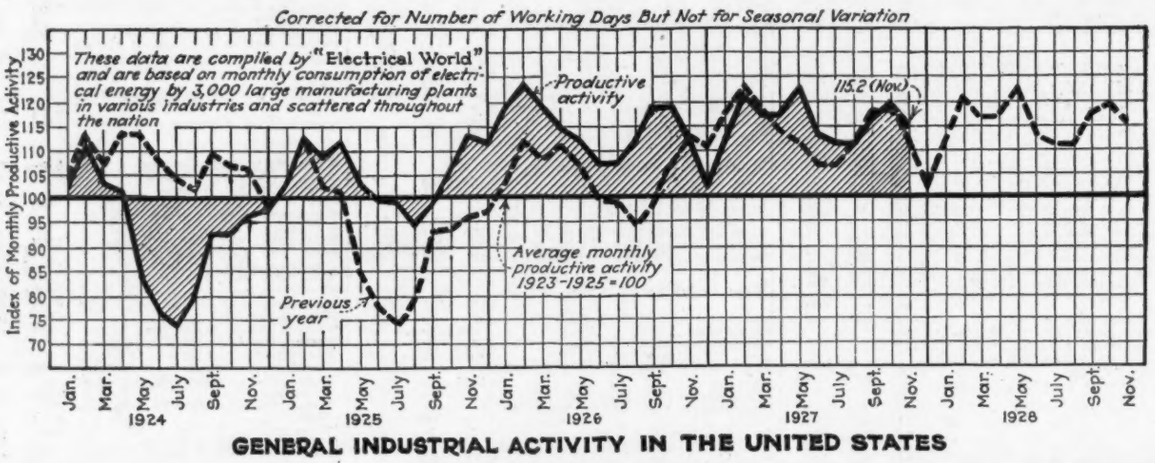
GENERAL industrial activity during November as indicated by the consumption of electrical energy by some 3,000 large manufacturing plants was about 3.8 per cent under October but was 3.0 per cent over November, 1926. All of the industrial groups except rubber and its products reported a rate of operations during November under that of October. Five of the industrial groups—rolling mills and steel plants, ferrous and non-ferrous metal-working plants, leather and its products, textiles, and stone, clay and glass—reported a rate of operations during November under that of November last year. On the other hand, six just as important industrial groups—lumber and its products, automobiles (including the manufacture of replacement parts), paper and pulp, rubber and its products, chemicals and allied products, and the food and kindred products industries—reported activities during November which were over those of 1926.

The index of activity in the manufacturing plants of the nation based on consumption of electrical energy stands at 115.2 for November as compared with 119.9 for October after adjustments are made for the number of working days in the two months. Comparative indexes of productive activity, referred to the average activity for the period 1923-1925 as 100 and adjusted for the number of working days, are as follows:

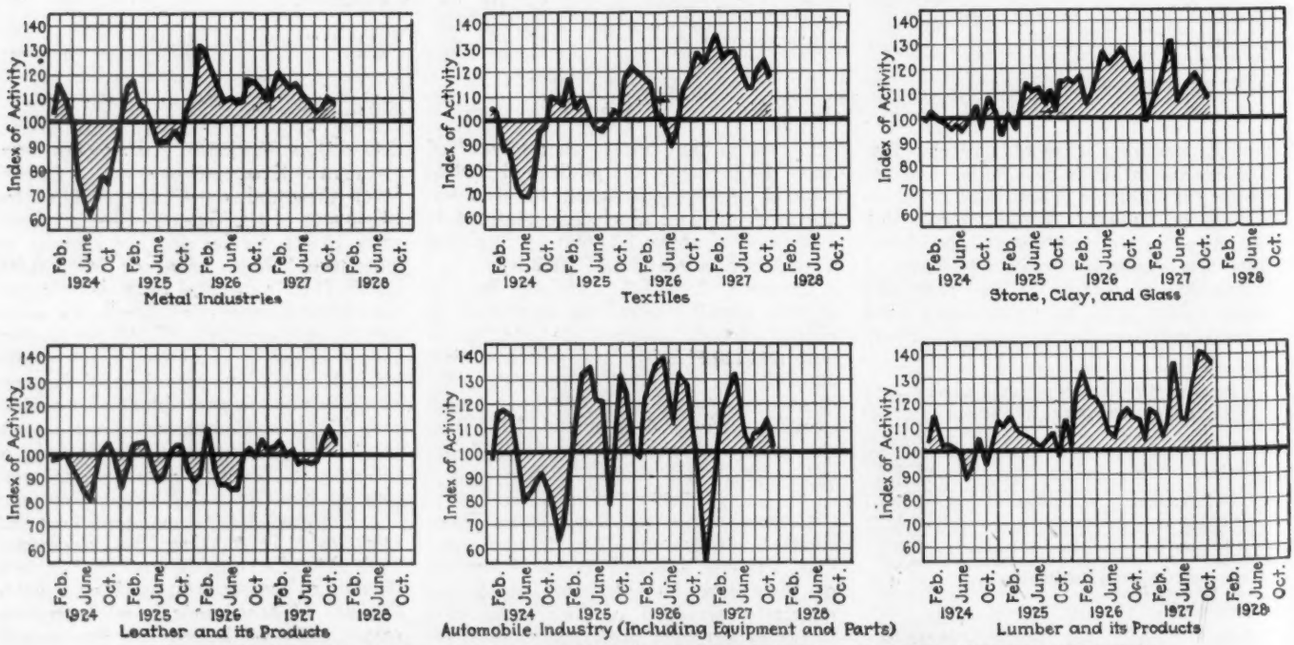
November, 1927	115.2
October, 1927	119.9
September, 1927	118.4
November, 1926	111.9
Average for first six months, 1927	116.8
Average for full year 1926	113.1

The most significant trend for the month was in the operations of the metals group, textiles industry and the automobile-manufacturing industry. The rolling mills and steel plants reported a rate of operations 2.5 per cent under October and 3.9 per cent under November last year. The ferrous and non-ferrous metal-working plants operated at a rate 3 per cent under October and 7.3 per cent under 1926. The textile plants of New England reported a drop in activities of 13.6 per cent during November, or to a point 13.5 per cent under November last year. The textile plants of the Southern States, however, appear to have increased their rate of operations by 4 per cent over October.

The figures for consumption of electrical energy indicate that while the number of new automobiles turned out during November was considerably under that of November last year, yet the manufacture of replacement parts was about 50 per cent over last year. The manufacture of replacement parts during the past few months for the twenty-three million automobiles now in use has materially exceeded that recorded this time last year. It appears that the manufacture of replacement parts now exerts a large influence on the general automobile industrial situation.


Corrected for Number of Working Days But Not for Seasonal Variation
These data are compiled by "Electrical World" and are based on monthly consumption of electrical energy by 3,000 large manufacturing plants in various industries and scattered throughout the nation
Productive activity
115.2 (Nov.)
Average monthly productive activity 1923-1925 = 100
Previous year
Index of Monthly Productive Activity
1924
1925
1926
1927
1928

GENERAL INDUSTRIAL ACTIVITY IN THE UNITED STATES



PRODUCTIVE ACTIVITY IN THE PRIMARY INDUSTRIES OF THE UNITED STATES

Business News and Market Conditions

High Construction Activity Continues in November

Total for Eleven Months of 1927 Surpasses Aggregate Figures for All of the Preceding Twelve Months

CONTRACTS awarded in November amounted to $257,322,000, an increase of 2.1 per cent over October, 1927, and 20 per cent over November, 1926, according to the *Engineering News-Record*, which included reports for four weeks for each of the months here compared. The year 1927 to date is 9.7 per cent higher than the same period last year. Awards for private work this year are 5.9 per cent ahead of 1926 and public contracts 15.8 per cent more than last year. Based on the construction volume index, which makes allowance for the decrease in construction costs during 1927, contracts for all classes of work are 11 per cent higher than they were in the first eleven months last year.

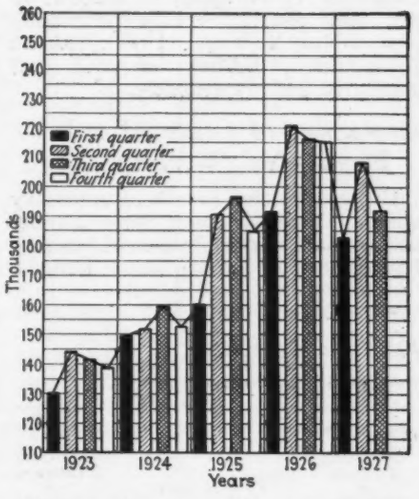
Commercial building in 1927 increased 7 per cent over the first eleven months of last year. About 84 per cent of commercial building is private, and this class increased 6 per cent, while public building increased 13.3 per cent. Although industrial building contracts are 100 per cent larger than last month, the year to date is 0.65 per cent less than the same period last year. The industrial contracts for November are considerably larger than any month on record, and one large project, a factory to cost $37,500,000 being constructed at Happy Valley, Tenn., for the American Glantzstoff Company accounts for this large volume. Contracts in 1927 for all buildings increased $92,951,000, or 5.6 per cent, over the same months last year, and construction other than building increased $158,727,000, or 16.2 per cent. November building awards were larger than any month on record.

The sections of the country in which awards during 1927 have been in larger volume than the first eleven months of 1926 are Middle Atlantic, Middle West, West of Mississippi, and Far West. All classes of construction except waterworks and industrial building exceed the 1926 totals. Compared with last month, November shows increases in waterworks, industrial and commercial building and all private construction.

This year has reached in eleven months the volume recorded in the twelve months of last year and exceeds 1926 by 0.84 per cent. Classes of construction contributing to this larger volume which show totals to date larger than at the end of 1926 are sewers, bridges, excavations, streets and roads, public building and unclassified work. All private work is 2.3 per cent under and public work 6 per cent over the 1926 totals.

The figures shown in the accompanying table are based on a minimum for each class. The construction volume index number is 272 for the month of November and 228 for the whole of 1926, as against 100 for 1913. This means that the actual volume of contract letting in 1926 (not the mere money value of the contracts let that year) is 128 per cent above the volume for 1913.

Sales of Electric Washing Machines by Quarters



Note—During the month of April, 1927, sales of electric washing machines amounted to 78,993 and established a new monthly sales record in the history of the washing-machine industry. The previous record was set in September, 1926, when sales amounted to 76,308. In the third quarter of this year 191,842 electric washing machines were sold, the smallest business done in that period since 1924.

Tax Returns Show Corporation Dividends

Corporations of all kinds on the average paid better cash dividends in 1925 than in either of the preceding two years, but manufacturing companies did so despite the fact that they were working on a narrower margin of profit than in 1923, the last previous "good" year, according to an analysis of corporation incomes made by the National Industrial Conference Board. In 1925 less of the consumer's dollar went into manufacturing and selling profit than in 1923 and the greater aggregate earnings were due to greater volume of business but at less profit per sale. Whereas in 1923 $6.07 out of every $100 of the aggregate receipts of all manufacturing corporations represented net profit, in 1925 a considerably larger volume of goods was produced at a profit of only $5.85 out of every $100 of receipts. The profit margin in trade decreased from $2.64 for every $100 received in 1923 to $2.26 per $100 of total receipts in the year 1925.

Industry or Business	Per Cent Ratio of Net Profits to Receipts	Per Cent Ratio of Cash Dividends to Receipts
Agricultural	1.75	3.89
Mining	5.38	6.79
Manufacturing	5.85	3.65
Construction	4.64	3.03
Trade	2.26	1.27
Finance	15.30	7.00
All corporations	6.21	3.79

Banks, insurance companies and other corporations engaged in finance as a group had a good year, more than 15 per cent of their aggregate receipts in

Value of Contracts Let in the United States and Canada During November, 1927

(Thousands of dollars—000 omitted)

	New England	Middle Atlantic	South	Middle West	West of Mississippi	Far West	United States	Jan. 1 to Dec. 1, U. S.	Canada
Waterworks	$32	$517	$15	$914	$1,214	$608	$3,300	*$50,634*	$89
Sewers	503	1,284	624	4,421	791	648	8,271	*110,481*	78
Bridges	25	2,699	2,059	1,422	1,321	703	8,229	*127,880*	.....
Excavations, drainage	.....	68	474	76	138	96	852	*40,201*	323
Streets and roads	425	3,185	1,674	4,305	15,246	5,043	29,878	*486,456*	442
Industrial buildings	2,213	3,865	42,917	6,545	4,438	1,041	61,019	*289,355*	522
Commercial buildings	11,374	62,756	4,484	38,112	6,942	10,668	134,336	*1,456,707*	4,867
Federal government	23	814	282	497	23	1,995	3,634	*47,034*	.....
Unclassified	440	995	263	5,355	700	70	7,803	*267,174*	5,034
November, 1927	$15,035	$76,183	$52,792	$61,627	$30,813	$20,872	$257,322	.....	$11,355
October, 1927	9,360	81,485	21,994	53,262	46,591	39,296	251,988	.....	29,795
November, 1926	24,031	53,508	26,659	56,660	24,303	21,860	206,821	.....	40,313
Jan. 1 to Dec. 1, 1927	*212,624*	*854,869*	*260,416*	*709,228*	*493,467*	*345,318*	*2,875,922*	*$2,875,922*	*129,687*
Jan. 1 to Dec. 1, 1926	227,349	791,276	269,319	666,719	381,543	285,977	2,622,183	2,622,183	140,700

1925 representing net profits, as against about 10 per cent in 1923. Despite their greater margin of profit and unlike corporations in other fields, they turned more than half of their profits into capital increment and paid out a smaller proportion of their total receipts as cash dividends.

Census of Manufactures Starts Jan. 10

The Bureau of the Census is making plans for the next biennial census of manufactures, which will cover the year 1927.

In deciding upon the items to be covered by the census, the bureau has consulted representatives of various manufacturers' associations. Recognizing the value of this census to the lighting equipment industry, at least one association — the Artistic Lighting Equipment Association—has arranged to co-operate with the Bureau of the Census in collecting the data for the coming census.

The blank forms upon which reports should be made will be mailed by the Census Bureau to all manufacturers about Jan. 10. A report will be required from each manufacturing establishment whose output in 1927 was valued at $5,000 or more. The bureau expresses the hope that every manufacturer concerned will have his records in such condition that he can fill out the schedule within a few days after its receipt, as the tabulation of statistics will not be made by the Bureau of the Census until reports are received from all manufacturers engaged in it.

Market Conditions

NEW ENGLAND, the Southeast and the Pacific Coast report some notable individual orders or plans involving electrical equipment. Electrification of the Boston, Revere Beach & Lynn Railroad will involve $1,000,000. Three industrial orders in Alabama, Georgia and New Orleans total $132,000. An inquiry for $65,000 worth of poles came from California, which is also the source of a single thirty - five - thousand - dollar industrial contract. Rehabilitation of lumber mills during the usual overhaul period has developed demands for motors in the Northwest, and Seattle is asking for bids on Skagit River equipment. Motor and control sales lead in industrial buying around New York, one manufacturer reporting 40 per cent increase over eleven months of 1926. Everywhere domestic appliances are selling strong, apparently for holiday gifts, and electric ranges seem to rank in this class in the Northwest. A manufacturer in the Southeast reports appliance business 15 per cent ahead. Utility purchasing around New York and in the Southeast is apparently holding off until 1928 appropriations are available.

Copper at 14 Cents—Lead Firm—No Interest in Zinc

Copper and zinc have been extremely quiet. There has been some activity in lead, but the total volume of business has declined. Recent metal business has been so good that even with increased consumption requirements early in the new year not much buying is expected until after the holidays. Whether or not prices will decline in the event of a pronounced let-up in demand during the next three weeks depends in large measure on the attitude taken by sellers.

The week ended Dec. 14 was one of the quietest of the year so far as copper was concerned. Most of the larger producers have held throughout the week at 14⅛ cents delivered in the East and 14¼ cents in the Middle West, with the few sales that they have made largely confined to the higher freight rate points. Copper appeared on the market as early as Saturday, however, at 14 cents delivered in the East, and by Dec. 14 offers at this level had appeared in several directions. Little interest was taken by consumers, however, and it is evident that supplies of prompt copper are adequate.

NEW YORK METAL MARKET PRICES

	Dec. 7, 1927 Cents per Pound	Dec. 14, 1927 Cents per Pound
Copper, electrolytic	14.125	14
Lead, Am. S. & R. price	6¼	6¼
Antimony	11½	11½
Nickel, ingot	35	35
Zinc spots	6.20	6.05
Tin, Straits	59	58¼
Aluminum, 99 per cent	25	25

Base copper price Dec. 7, 1927, 16 cents.

Lead buying has been in considerably smaller volume than during the preceding week, but aside from some slight tendency in the Middle West to shade prices in order to attract buyers, quotations are unchanged. The fact that one of the important sellers has sold virtually all of his production through January and is not seeking business has helped keep down the amount of business.

Prices for zinc have gradually weakened from the level of a week ago, the net decline for the week being about one-eighth following the activity of November.

Million-Dollar Electrification Project for New England

Outstanding in interest in this district during the past week is the announcement of the Boston, Revere Beach & Lynn Railroad that it will electrify about 44 miles of narrow-gage road, using an overhead catenary system. Two permanent substations and one portable station will be built. An order for 60 50-hp. special General Electric motors has been placed. Terminals will be modernized with new lighting systems. Power will be purchased. The estimated cost of the project is placed at about $1,000,000.

An encouraging increase in demands for prices on power equipment is reported. Inquiries for turbo-generators

Delinquent Electrical Accounts

(Data Supplied by National Electrical Credit Association)

NUMBER OF ACCOUNTS REPORTED

Division	October 1926	October 1927	Per Cent Increase or Decrease	Ten Months 1926	Ten Months 1927	Per Cent Increase or Decrease
New York	242	267	+10.3	3,603	3,126	—13.2
New England	103	148	+43.6	925	1,552	+67.7
Pacific Coast	5	17	+240	230	169	—26.5
Central	673	794	+18	8,635	8,017	+4.42
Middle and Southern Atlantic	188	139	—26	1,901	1,685	—11.4
Total	1,211	1,365	+12.7	15,294	15,549	+1.67

TOTAL AMOUNTS REPORTED

Division	October 1926	October 1927	Per Cent Increase or Decrease	Ten Months 1926	Ten Months 1927	Per Cent Increase or Decrease
New York	$34,440	$36,521	+6.04	$527,619	$488,619	—7.42
New England	7,123	19,079	+167.8	84,662	183,181	+116.3
Pacific Coast	673	1,239	+84.1	34,975	20,238	—42.1
Central	80,757	76,550	—5.21	960,258	991,845	+3.29
Middle and Southern Atlantic States	21,465	23,217	+8.16	221,579	206,063	—7
Total	$144,458	$156,606	+8.41	$1,829,093	$1,889,946	+3.33

AVERAGE AMOUNTS

Division	October 1926	October 1927	Ten Months 1926	Ten Months 1927
New York	$142	$137	$1,456	$1,563
New England	69	128	932	1,181
Pacific Coast	134	72	1,477	1,473
Central	119	96	1,117	1,100
Middle and Southern Atlantic States	114	167	1,113	1,235

Note:—A sharp increase in accounts is reported by the New England division. This is owing to increased association activity in this section and not to adverse economic conditions.

are gaining. A few small orders were placed for transmission-line supplies, and two substation equipment orders were recently placed in northern New England amounting to about $5,000. Small-motor sales are steady, with machine-tool manufacturers interested in fractional sizes. Interior lighting contracts are far in excess of last year, and several large installations are being planned. One recently placed called for 250 kw.; another will run over 200 kw. The more expensive types of lighting units are receiving attention. The Buchanan & Layng Corporation, New York, has been appointed to report on the assets of the Boston & Worcester Street Railway, with the purpose of preparing for complete rehabilitation of this system.

Proposed construction includes the following: The Connecticut Light & Power Company, Waterbury, has filed plans for a two-hundred-thousand-dollar equipment storage and distributing building at Greenwich, Conn. The Lynn Gas & Electric Company has plans for an addition to its power plant, to cost $750,000.

Two Southeastern Contracts Involve $120,000

Few orders of any moment are being placed for electrical equipment in the Southeast, there being a tendency to hold up purchases until the new year's budgets are available. A lumber company in Alabama last week purchased a turbine and switching equipment totaling $60,000, while an industrial contract in Georgia will involve electrical materials to the extent of approximately $60,000. Another satisfactory order, amounting to $12,000, was for a water-pumping switchboard for New Orleans. Two small switchboard orders aggregating $7,500 were placed in middle Georgia. Central-station purchases are considerably off, except in merchandise lines, though one company ordered last week $6,600 worth of aluminum wire and cable and creosoted pine poles amounting to $5,000. Another power company order called for $2,700 worth of insulators and distribution transformers amounting to $1,400.

One jobber reports the receipt this week of two orders from Georgia for industrial inside wiring materials totaling more than $8,000. Manufacturers state that heating appliances, large and small, are going excellently. One of the leading manufacturers reports that his business in this section, Florida excepted, is running 15 per cent ahead of the same period of last year, with prospects for the increase registering 20 per cent in the spring months. A job was recently closed on a small hotel for a complete electric kitchen to cost in excess of $5,000.

From the South came such construction reports as: The Mississippi Central Power Company will extend its transmission lines and construct two new substations. The Du Pont Rayon Company, Buffalo, contemplates a five-million-dollar power plant near Richmond, Va. The Mead Paper Company, Dayton, Ohio, plans an electrically operated pulp mill at Sylva, N. C., to cost $200,000.

Greater Activity Seen in Middle West

General business in the Middle West section continues to improve. While considerable unemployment in the building trades is noticeable, this is largely a seasonal situation, and, with the number of large projects being started, should materially improve within the next sixty days. Receipt of an increased volume of unfilled orders by the steel companies reflects greater activity in the railroad, automobile, and farm implement fields. Utility purchases are gradually increasing. Among the interesting orders placed this week were the following items:

Distribution and subway transformers valued at $250,000, ash-handling equipment for six boilers complete with appurtenances, 45 450-amp., 12,000-volt current-limiting reactors and 975 Thompson meters ranging from 10-amp. to 800-amp. capacity. Pole-line hardware manufacturers report good business, and weatherproof wire mills are rapidly selling their output.

The holiday season is in full swing and jobbers' sales are increasing daily. The outlook is very promising for a good electrical season with all appliances moving readily. Prices are generally firm. Lead-covered wires and cables advanced 5 per cent in price this week following the advance in lead prices last week. Several increases in the base price of weatherproof wires and cables were announced. One important price advance this week was the standardization of weatherproof extras.

General construction projects are reported: The Terminal Cold Storage Company, Chicago, Ill., will ask bids in about 60 days for a two-million-dollar cold-storage terminal and refrigerating plant. The Veterans' Bureau is asking bids until Dec. 20 for a refrigerating plant for the hospital at Dwight, Ill. Evanston, Highland Park, Ill., and Lake Forest, Ill., are planning ornamental lighting systems, the second to cost approximately $75,000. The Kalamazoo, Mich., Vegetable Parchment Company is planning an expansion program, with new mill units and machinery, to cost $1,500,000. The Consolidated Paper Company, Monroe, Mich., has plans for a new five-hundred-thousand-dollar addition. Alexandria, Minn., is planning for a sixty-thousand-dollar addition to its electric plant. Willmar, Minn., is arranging for a forty-thousand-dollar addition to its power plant. Harvard, Neb., is considering a municipal plant to cost $59,000. The Neligh (Neb.) Electric Light Company has plans for a one-hundred-thousand-dollar power plant. The Firestone Tire & Rubber Company, Akron, plans to construct a million-dollar power plant.

A 1,500-kw. turbine unit with accessories, and a lot of motors, totaling about $65,000, were included in a recent order from the South. Planned construction includes the Arkansas Power & Light Company, which is planning a distribution system for Earle, Ark. Armour & Company plan to rebuild two cold storage and ice plants and a fertilizer factory at Kansas City, Kan. The Empire District Electric Company will build a one-story substation at Joplin, Mo. The Sand Springs (Okla.) Power, Light & Water Company will expand and improve its power plants and transmission system, at a cost of about $2,000,000. Denton, Tex., is considering an ornamental lighting system. The Texas-Louisiana Power Company plans a $200,000 power plant and cold storage plant at Whitewright, Tex., with a transmission line. The Central Power & Light Company is planning a $75,000 power plant in the town of Edcouch, Tex.

Northwest Range Sales and Lumber-Mill Rehabilitation

Midwinter overhauling of numerous lumber-manufacturing plants in northwestern Washington is expected to increase motor sales, particularly smaller types, according to the movement already noted. Sales for replacements and minor additions to mills and woodworking plants include approximately 200 hp. in motors from 10 hp. down, mainly tens and fives. Inquiries for smaller types are more numerous than for months. Other sales include several from 10 hp. down for a Seattle machine shop, a steel mill, a heating plant and a foundry, while a Seattle grain elevator bought two twenties and one ten. A supplemental order for ten 7½-hp. and 10-hp. motors was placed by a Tacoma lumber plant, and a Seattle jobber reported a sale of a fifteen, a ten and two fives for a ventilating system at the state reformatory. Range sales in the Seattle and Puget Sound district are considerably ahead of last year, many being for Christmas gifts because of campaigns of central stations started Dec. 1. Other electrical gift merchandise is moving about the same as last year. Seattle is calling bids until Jan. 6 for about $100,000 worth of gates, valves and hoists for the Diablo Dam.

Action on awards for approximately $150,000 worth of generating equipment for the Cedar Falls plant is expected on Dec. 16. Specifications for approximately 2,500 hp. in motors for a three-million-dollar cement plant of the Pacific Coast Cement Company, Seattle, may be expected late next spring. Decision whether to generate or purchase power remains to be made.

Construction plans are reported as follows: The City Council of Morton, Wash., is asking bids until Dec. 27 for the construction of a transmission line from the city of Tacoma's power plant near Alder, Wash., with a substation at Morton, involving about $60,000. The Montana-Dakota Power Company will construct a substation at Terry, Mont.

The Main Street Improvement Association, Salt Lake City, plans extension of its ornamental lighting system.

Encouraging Industrial Sales in Eastern District

Marked activity has developed in certain lines of industrial electrical equipment in the New York district, with motors and control apparatus taking the lead. The sales of one manufacturer show that November business increased about 25 per cent over the preceding month, and December sales are exceeding those of November. Present inquiries are reported to be coming in satisfactorily for future deliveries, and there is promise of continuance of current activity. Fans, another specialty of this manufacturer, are duplicating the motor-sales record and, likewise, have a bright future.

Sales of control equipment have increased 40 per cent during eleven months compared with the same period in 1926. Present business centers in industrial accounts, and large baking interests constitute an important factor in the immediate demand.

While central-station business maintains a satisfactory level, the bulk of the activity is centered in power-station requirements. Transmission equipment, particularly line hardware, is moving rather slowly. Inquiries look promising, but there is no real certainty in current account nor likelihood of any substantial orders until well after the turn of the year.

Call for insulation materials has slackened temporarily, immediate sales not being up to the average of a few weeks ago. Following the holidays a resumption of activity is anticipated. Wire and cables are in fair demand, and fuse sales are low, owing to the season of the year. Electric appliances are moving well, with vacuum cleaners and kindred specialties developing strength compared with a month ago. Electric refrigerators are active.

Trade in Philadelphia shows no important change. An improved call is evidenced for industrial installations, with motors in better demand. Increased business is looked for in the metal-working trades. While inquiries are developing for central-station equipment, the majority of commitments will follow the turn of the year, when substation apparatus is expected to move better. Orders for transmission equipment are below average at this time. Domestic appliances are moving well for holiday account.

Current construction activities in the Eastern District include the following: The New York Edison Company will erect a service and operating building to cost $450,000. The Atlantic City Electric Company is negotiating for the electric system in Gibbstown and vicinity and plans line extensions and improvements there. The Pennsylvania Power & Light Company is reported planning the construction of a new power plant in the vicinity of Mount Carmel. The Edison Electric Company, Lancaster, Pa., has secured a right-of-way through West Hempfield Township and is said to be planning line construction. The Post Office Department, Washington, D. C., is asking bids until Dec. 21 for two motor-generator sets. The Pennsylvania-Ohio Power Company has made application for construction of a transmission line across the Mahoning River, near Girard, Ohio.

Inquiry for $65,000 Worth of Poles on Pacific Coast

The outstanding inquiry of the past week is for 5,000 untreated poles (value approximately $65,000) to be shipped during 1928 to the Pacific Gas & Electric Company. Sizes range from 7-in., 35-ft., to 9-in., 65-ft., but about two-thirds of the poles are 8-in., 35-ft. and 40-ft. sizes. Another sizable power inquiry covers 150,000 ft. of ½-in. and ⅜-in. guy strand for the Great Western Power Company. Other orders include 15,000 lb. of line hardware for Yerington, Nev.; two carloads of poles for Bakersfield, and poles and cross-arms for a small power line near Chico. California state department orders include $1,500 worth of wiring material, four hotel-type ranges valued at $4,000 and $1,000 worth of miscellaneous material. An inquiry for Australian export covers 5,000 push-through sockets with plugs and silk cord for desk portables.

Unexpected snow along the Coast Range has caused a fine heater demand. Maintenance tools for power companies are also reported in jobbers' sales. Business from industrial concerns covers such items as a twenty-five-hundred-dollar motor-generator set for a sugar refinery, seven transformers ranging from 5 kva. to 57½ kva. for an oil company, three 150-hp. motors for a Nevada gold mine and a thirty-five-hundred-dollar distributing switchboard for a club house. An outstanding industrial order covering nine transformers totaling 2,260 kva. and cable, switches and lightning arresters, amounting to $35,000, was made by a lumber company.

Pending construction includes such items as: The Chamber of Commerce, Calexico, Cal., has indorsed an ornamental lighting system to cost about $75,000. The Diamond Springs (Cal.) Lime Company is planning a four-hundred-thousand-dollar mill and tramway system. The Los Angeles Gas & Electric Company is contemplating a second unit for its Seal Beach plant, to cost about $750,000. San Mateo, Cal., plans an improved lighting system. The Red River Lumber Company, Westwood, Cal., has applied for permission to construct a hydro-electric plant on Ash Creek to cost $250,000 with transmission line. The Western Railways Ice Company, Denver, Colo., is considering an addition to its Alamosa plant. Winnemucca, Nev., is considering an improved municipal lighting system. The Washington Water Power Company has prepared for a one-story substation in Spokane.

Activities of the Trade

Two St. Louis Jobbers Consolidated by Westinghouse

Rumors of the consolidation of two large electrical jobbing houses in St. Louis have been confirmed by the official announcement that the Westinghouse Commercial Investment Company has purchased the Commercial Electrical Supply Company, which will be consolidated with the McGraw Electric Appliance Company. The consolidation is to take effect on Jan. 1, and the new company will operate under the name of the Commercial Electrical Supply Company.

William H. Nolker, president of the old Commercial Electrical Supply Company, is to be president of the new organization, and R. Delano, vice-president and general manager of the McGraw Electric Appliance Company, is to fill the same positions in the new organization. F. D. Phillips, vice-president of the H. C. Roberts Electric Supply Company, Syracuse, New York, will be general sales manager of the new company. The company will occupy the present location of the Commercial company at 320 South Broadway. The McGraw Electric Appliance Company at Memphis, Tenn., will be known as the Memphis house of the Commercial Electrical Supply Company and will continue under the management of William F. Cleveland.

American Transformer Company Reorganizes

Following the recent death of W. F. Hubley, president and general manager of the American Transformer Company, Newark, N. J., the personnel of the organization has been arranged as follows: A. E. Hubley, president; M. H. Harold, vice-president and treasurer; C. M. Lum, secretary and counsel; A. A. Hubley, assistant secretary and assistant treasurer; J. L. Schermerhorn, manager and chief engineer; T. M. Hunter, engineer and sales manager of industrial transformers, and W. J. Cassels, factory superintendent. No recent additions have been made in the organization, and production will continue as in the past in the manufacture of industrial transformers, radio parts and assembled units.

THE TRUMBULL-VANDERPOEL ELECTRIC MANUFACTURING COMPANY, Bantam, Conn., has issued price changes on its new meter and entrance switches. The prices became effective on Nov. 23.

WESTINGHOUSE AWARDED FISHER BUILDING ELEVATOR CONTRACT. — Elevator equipment for the new thirty-five-million-dollar Fisher Building at Detroit, will be furnished by Westinghouse-Kaestner & Hecht, according to E. H. Sniffin, executive of the Westinghouse Electric & Manufacturing Company. Twenty-five elevators will be involved. Those serving the main office section will include floor self-leveling and automatic door control, a preregister control system which assures their stopping at the floor called and dispatcher's control with the latest signal system. The elevators will also incorporate other features providing accuracy, safety and control.

THE GENERAL ELECTRIC COMPANY has purchased 92 acres of land from the Pittsfield Industrial Development Company. The land is between the company's main transformer works and porcelain plant and contiguous to railroad connections. Its purchase will permit greater efficiency in the operation of the present plants through better connections and will provide from for future expansion when necessary.

THE OHIO BRASS COMPANY, Mansfield, Ohio, announces that H. W. Kilkenny, representative in the Pittsburgh district for the past four years, has been transferred to the St. Louis district. Mr. Kilkenny has been succeeded in the Pittsburgh territory by S. W. Walworth, who recently joined the Ohio Brass Company after a three-year association with the Pittsburgh Transformer Company, which he represented in a sales capacity in the Pittsburgh territory.

THE W. B. WILDE COMPANY, Peoria, Ill., manufacturer of the "Hart" oil burner, has been reorganized. At a recent directors meeting the following officers were elected: A. E. MacInnis, president; Richard S. Bohn, vice-president; Spencer A. Merrell, vice-president; Lionel V. Tefft, secretary, and J. Paul Schnellbacher, treasurer.

THE SPRAGUE ELECTRICAL SUPPLY COMPANY, Waterbury, Conn., announces that M. G. Francoeur, formerly with the Hartford Electric Supply Company, has been appointed to its sales staff.

THE LINCOLN ELECTRIC COMPANY, Cleveland, manufacturer of "Linc-Weld" motors and "Stable-Arc" welders, announces the appointment of R. M. Plympton as salesman in charge of consumer motor business in Chicago. Mr. Plympton will work under the direction of R. D. Malm, Chicago district manager. E. F. Hoff has been transferred from the welder division at Cleveland to the welder division at New York, where he will be in charge of welder service under the direction of G. N. Bull, district manager. R. P. Nick, formerly at Baltimore, has been transferred to Lancaster, Pa.

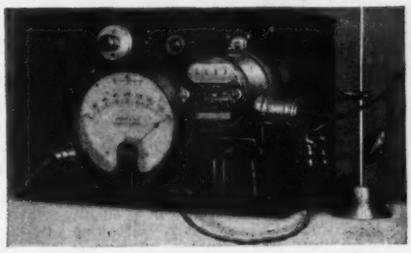
New Equipment Available

Threadless Conduit Fitting

The FI series of "Kondu" threadless conduit fittings was designed by the Erie Malleable Iron Company, Erie, Pa., for connecting fiber conduits to metallic conduits. The fiber conduit is clamped to the sleeve by a clamping bolt at such a level that the cap on the sleeve will extend slightly above the concrete. The cap may be easily freed from the concrete and the desired adapter screwed into place. The ribs on the body prevent turning of the sleeve. The sleeve to clamp fiber conduit is made in 2-in., 3-in. and 4-in. sizes and there are three sizes of adapters for the iron conduit for each sleeve. The regular "Kondu" reducer can be used to give other reductions if desired.

Meter-Testing Device

A device built along the principle of the stroboscope for meter testing has recently been developed by H. P. Sparkes, special engineer of the Westinghouse Electric & Manufacturing Company. The company claims that the



SPEED OF METER DISK OBTAINED BY STROBOSCOPIC EFFECT

device will save electric light and power companies a great deal in the cost of meter testing. The speed of the rotating element of the meter is measured by viewing a series of marks on the element through a synchronized flickering light beam. When the marks appear to stand still the stroboscopic light is synchronized with the speed of the meter disk. A pointer indicates the percentage over or under the correct reading. Less than ten minutes is required to calibrate a watt-hour meter, using the stroboscopic device test.

Remote Indicating and Recording Instruments

The Tanner remote indicator and remote recording meter for indicating and recording respectively the level of water or other liquid in storage tanks, reservoirs, brine tanks and ponds, for hydro-electric-plant head water, or for indicating any straight line or angular motion or displacement, has been developed by the Tanner Engineering Company, Inc., Rawson Street and Nelson Avenue, Long Island City, N. Y. Both instruments are electrically operated with two-wire units with a ground return. The indicator is for operation on 100 to 250 volts alternating or direct current, and the recorder for 110 to 130 volts alternating or direct current. The operation is not affected by even comparatively large fluctuations in voltage. The distance of transmission may be any distance from a few feet to several miles. By means of suitable switches one indicator may be used to indicate information from several transmitters. The indicator has the general appearance of a switchboard voltmeter, and the recorder is of the circular chart type using an 8-in. chart which can be supplied with either a 24-hour or a seven-day movement.

Ironclad Starting Switch

The Electric Controller & Manufacturing Company, 2700 East 79th Street, Cleveland, is now supplying its standard-type ZO across-the-line starting switches for small alternating-current motors in ironclad tanks to make them suitable for operation in atmospheres where acid fumes are present. There is a machined fit between the cast-iron cover and tank, thus making the starter rainproof. Like the standard-type ZO starting switches, all of the contacts, including the overload trip, open and close under oil so that this starter is flame-proof.

Electric Furnaces

A new line of "American" electric rectangular pot furnaces for lead, salt or cyanide has been placed on the market by the American Metallurgical Corporation, 27 Von Hillern Street, Boston. The stock sizes of pots available are 18 in., 24 in., 36 in. and 48 in. long by 12 in. wide and 17 in. deep, with a rated capacity of from 150 lb to 450 lb. per hour at 1,500 deg. F. The manufacturer states that the furnace is ruggedly constructed and requires virtually no maintenance. The heat chamber is of ample size to contain electric heating elements, allowing proper clearance for the removal and installation of pots, and is designed for the rapid and uniform distribution of heat. The side walls are constructed of a first-quality refractory tile set in high-temperature cement and are backed up by the highest grade of installation. Nickel-chromium alloy heating elements are used.

The company has also placed on the market an addition to its line of stock furnaces consisting of a 6-in.x10-in. pot furnace to be used for lead, salt or cyanide hardening and for aluminum and white metal melting. The furnace has a capacity of 7½ kw. and has an over-all dimension of 36 in. in height with a diameter of 27 in. and an operating range of 1,650 deg.

Electrical Patents

Announced by U. S. Patent Office

(Issued Nov. 29, 1927)

16,804 (reissue). ELECTRIC BUTT-SEAM WELDING AND APPARATUS THEREFOR; F. L. Sessions, Lakewood, Ohio. App. filed Nov. 5, 1925.

1,650,593. PROTECTION OF ELECTRIC SYSTEMS; J. Biermanns, Karlshorst, Germany. App. filed Jan. 8, 1926.

1,650,601. SWITCHING DEVICE; J. Bruynes, Eindhoven, Netherlands. App. filed May 12, 1924. Adapted for use with a tungsten lamp to reduce the initial flow of current when cold.

1,650,602. ELECTRIC LAMP; R. S. Burnap, East Orange, N. J. App. filed Jan. 30, 1926.

1,650,604. ELECTRIC REGULATOR; F. A. Byles, Schenectady, N. Y. App. filed Oct. 17, 1924. For exciter system.

1,650,605. FILAMENT FOR INCANDESCENT LAMPS OR SIMILAR ARTICLES; P. A. Campbell, Cleveland, Ohio. App. filed Dec. 9, 1926.

1,650,624. CONTROL FOR ELECTRIC FURNACES; E. C. Glitzke, Kansas City, Mo. App. filed Nov. 19, 1926.

1,650,631. PROCESS OF PREPARING METALS WITH HIGH-TEMPERATURE FUSING POINTS SUCH AS TUNGSTEN AND OF PREPARING WIRE THEREFROM; F. Koref, Charlottenburg, and H. Alterthum, Halensee, near Berlin, Germany. App. filed Jan. 6, 1923.

1,650,632. ELECTRODE STEAM BOILER; S. Kowallik, Pankow, Berlin, Germany. App. filed April 13, 1926.

1,650,658. ELECTRIC FURNACE; J. A. Seede, Schenectady, N. Y. App. filed June 5, 1926. Electrode type.

1,650,664. FLOW METER; L. W. Thompson, Schenectady, N. Y. App. filed Oct. 7, 1924. For measuring flow of liquids through conduits.

1,650,675. ELECTRIC FURNACE; J. M. Weed, Scotia, N. Y. App. filed March 23, 1926. Electric metal melting furnace; electrode type.

1,650,676. EXIT LIGHTING SYSTEM; R. T. Williams, Chicago, Ill. App. filed Dec. 3, 1926.

1,650,679. ELECTRIC SPEED INDICATOR; R. E. Woolley, Schenectady, N. Y. App. filed Sept. 15, 1924. For indicating the speed of rotation of shafts.

1,650,779. TESTING ELECTRODE; A. F. Williams, Rochester, N. Y. App. filed Jan. 25, 1924. For testing electric apparatus for defects such as short circuits and defective insulation.

1,650,799. ELECTRIC SOLENOIDS; T. L. Lee, Rochester, N. Y. App. filed May 17, 1924.

1,650,833. EXTENSION COMB FOR LAYING UNDERGROUND ELECTRIC CONDUITS; C. D. Healy, Newark, N. J. App. filed Aug. 9, 1926.

1,650,849. CARBON FEEDING AND ADJUSTING MECHANISM FOR ARC LAMPS; W. G. Preddey, San Francisco, Calif. App. filed Feb. 1, 1926.

1,650,851. CONTINUOUS-CURRENT GENERATOR; E. Rosenberg, Weiz, Austria. App. filed Sept. 29, 1926.

1,650,869. MULTIPLE-SOCKET ELECTRIC PLUG; I. F. Giles, Yonkers, N. Y. App. filed Feb. 13, 1925.

1,650,870. ELECTRICAL CONNECTER DEVICE; M. Guett, Hartford, Conn. App. filed Feb. 16, 1924.

1,650,871. FLUSH WALL SOCKET; M. Guett, Hartford, Conn. App. filed April 18, 1924.

1,650,875. ELECTRIC SIGN; J. E. Long, Multnomah, Ore. App. filed Jan. 30, 1926.

1,650,878. CLOCK; C. H. Miller, San Jose, Calif. App. filed Aug. 1, 1925. To operate on alternating current.

1,650,879. MAGNETO ELECTRIC AND THE LIKE MACHINE; M. Schafer, W. Hahnle and W. Walther, Stuttgart, Germany. App. filed Aug. 26, 1921.

1,650,881. ARC LAMP; A. C. Roebuck, Chicago, Ill. App. filed April 17, 1922.

1,650,897. TUNGSTEN CONTACT-BREAKER ARM; A. J. Liebmann, New York, N. Y. App. filed Oct. 30, 1924.

1,650,905. WELDING ROD; O. L. Mills, Los Angeles, Calif. App. filed Dec. 21, 1925. Comprising a metallic container and a homogeneous welding composition in the container, the composition containing substantially all of the materials to be deposited by the weld.

1,650,909. SWITCH TUBE FOR CONTROLLING ELECTRIC CIRCUITS; R. Rüdenberg, Berlin-Grunewald, Germany. App. filed July 2, 1926. Mercury-vapor tube.

1,650,910. METHOD OF DE-ENERGIZING GENERATORS; R. Rüdenberg, Berlin-Charlottenburg, Germany. App. filed Nov. 25, 1924.

1,650,911. PORTABLE HAND TOOL; F. Schneider, Cleveland, Ohio. App. filed May 9, 1923. Of the power type.

1,650,924. ELECTRIC SWITCH; C. Aalborg, Pittsburgh, and O. A. Colby, Irwin, Pa. App. filed June 3, 1921.

1,650,932. RELAY SYSTEM; C. A. Butcher, East Pittsburgh, Pa. App. filed Dec. 21, 1923. To control the operation of synchronous motor-generator sets.

1,650,942. THERMOSTAT; L. P. Hynes and H. A. Williams, Albany, N. Y. App. filed Jan. 8, 1926.

1,650,943. AUTOMATIC-FEED RIVET HEATER; G. A. E. Jones, New London, Conn. App. filed May 20, 1921.

1,650,947. DYNAMO-ELECTRIC MACHINE; M. Latour, Paris, France. App. filed Sept. 29, 1924. High-frequency type.

1,650,968. CIRCUIT CLOSER; V. Tedeschi, Buenos Aires, Argentina. App. filed May 15, 1924. By means of which electric current or gas supply may be automatically cut off when an earthquake or similar seismic disturbance takes place.

1,650,970. AUTOMATIC STATION; R. J. Wensley, Edgewood, Pa. App. filed Feb. 12, 1925.

1,650,983. INSULATING STRUCTURE FOR HIGH-POTENTIAL CONDENSER TERMINALS AND THE LIKE; W. Dubilier, New York, N. Y. App filed Feb. 18, 1921.

1,650,986. LEVEL INDICATOR OR TELLTALE FOR OIL STILLS AND THE LIKE; E. C. Herthel and E. W. Isom, Chicago, Ill. App. filed Nov. 28, 1921.

1,650,996. FUSE; G. P. McDonnell, St. Louis, Mo. App. filed Nov. 16, 1923. With means for selectively indicating the condition or capacity of the fuse.

1,650,999. ELECTRICALLY HEATED UTENSIL; E. S. Preston, Chicago, Ill. App. filed May 19, 1927.

1,651,035. ELECTRIC SWITCH; G. J. Meuer, Milwaukee, Wis. App. filed June 8, 1921. Rotary switch for concealed mounting.

1,651,055. FUSE HOLDER; A. W. Fisher, Wilkinsburg, Pa. App. filed Dec. 15, 1925.

1,651,059. BRUSH-HOLDER CONNECTION; J. T. Janette, Chicago, Ill. App. filed Feb. 6, 1926.

1,651,061. MOTOR CONSTRUCTION; J. T. Janette, Chicago, Ill. App. filed Dec. 15, 1924. Using a sheet metal for an alternating-current motor.

1,651,074. ELECTRIC PERFORATING MACHINE; H. C. Steffens, San Francisco, Calif. App. filed Feb. 9, 1924.

1,651,078. FLOAT-OPERATED CIRCUIT CLOSER; C. E. Weisgarver and J. T. Harnish, Harrisburg, Pa. App. filed Dec. 30, 1922.

1,651,096. LAMP; F. A. Hart, New Britain, Conn. App. filed Feb. 1, 1926. Floor lamp with an adjustable extension arm.

1,651,119. ELECTROMAGNETIC CLOCK; L. Hatot, Paris, France. App. filed March 11, 1925.

1,651,175. ELECTRIC LAMP; F. A. Anderson, Milton, Wis. App. filed Sept. 29, 1922. For therapeutic purposes.

1,651,196. STORAGE BATTERY; T. A. Edison, Llewellyn Park, West Orange, N. J. App. filed May 14, 1923. Separators for nickel battery.

1,651,201. INSULATOR; M. F. H. Gouverneur, Victor, N. Y. App. filed April 7, 1921. For high-tension power transmission.

1,651,223. TRANSFORMER FOR ELECTRIC ARC CUTTING AND WELDING APPARATUS; F. C. Owen, Fayetteville, N. C. App. filed Nov. 12, 1925.

1,651,226. BATTERY-SEALING CONSTRUCTION; L. J. Pearson, Wyncote, Pa. App. filed April 25, 1922.

1,651,234. LEADING-IN BUSHING FOR HIGH VOLTAGES; J. Stolz, Berlin-Charlottenburg, Germany. App. filed March 31, 1927.

1,651,238. ROTARY ANNUNCIATOR DROP; F. W. Wood, Montclair, N. J. App. filed March 25, 1920.

1,651,252. SWITCH PLATE; N. Chesler, Brooklyn, N. Y. App. filed Feb. 27, 1925.

1,651,266. ROTATABLE ELECTRIC CONNECTER FOR CHAIRS; L. J. Fortier, Springvale, Me. App. filed May 3, 1926.

1,651,275. ELECTRIC SIGN CONTROLLER; H. Hirsch, Zurich, Switzerland. App. filed Sept. 24, 1923.

1,651,278. PROCESS OF PRODUCING CORROSION-RESISTING COATING ON IRON AND STEEL AND PRODUCTS; C. H. Humphries, Kokomo, Ind. App. filed June 5, 1924. Chromium coating.

1,651,283. LOCK FOR ELECTRICAL CONNECTERS; R. F. Landrum, Norfolk, Va. App. filed May 10, 1924. For locking an electric lamp to its socket.

1,651,287. ELECTRIC INCANDESCENT LAMP MADE OF GLASS TUBING; H. Mayer, Berlin-Lichterfelde-West, Germany. App. filed March 30, 1927.

1,651,294. BATTERY TERMINAL; J. Rumore, Bessemer, Ala. App. filed April 9, 1926.

1,651,303, 1,651,304. BELL; G. M. Thaden, Reading, Pa. Apps. filed May 15, 1926. Wherein the ringing mechanism is confined within the walls of the bell and base.

1,651,306. RECIPROCATING ELECTRIC MOTOR; C. S. Weyandt, Pittsburgh, Pa. App. filed March 5, 1924.

1,651,314. ELECTRICAL SWITCH; J. W. Beasley, Jr., Los Angeles, Calif. App. filed Oct. 20, 1922. Of the rotary type, in which a pivoted arm is used as a movable element and a plurality of contacts as the stationary elements.

New Trade Literature

SWITCHES AND MOTORS.—Bulletins GEA-831 and GEA-822 issued by the General Electric Company, Schenectady, N. Y., describe and illustrate its manually and solenoid-operated field switches and alternating-current and direct-current general-purpose motors with ball-bearing construction.

SIGN CONTROL.—The Reynolds Electric Company, 2650 West Congress Street, Chicago, has issued bulletin No. 802, describing controls for electric score-board figuregrams.

DIRECT-CURRENT MACHINES. — The Allis-Chalmers Manufacturing Company, Milwaukee, is distributing bulletin No. 1142, describing and illustrating its engine-type direct-current machines, types "IC" and "ICW."

ALTERNATORS. — Bulletin No. 151 issued by the Ideal Electric & Manufacturing Company, Mansfield, Ohio, gives full information concerning the six different types of alternators it manufactures. Included in the bulletin are cuts and tabulations of dimensions for outline prints.

REFLECTORS.—Catalog No. 27 issued by the Reflector & Illuminating Company, 1401 West Jackson Boulevard, Chicago, describes and illustrates its "Sterling" silvered glass reflectors for show windows, showcases, wallcases, floodlighting, cove and general interior illumination. Attention is also called to its "Ready-2-Install" system of wiring for interior and exterior lighting, which is adapted for wiring in display windows.

UTILITY EQUIPMENT.—The James R. Kearney Corporation, 4224 Clayton Avenue, St. Louis, has issued bulletins Nos. 311, 312, 314, 327, 328 and 329, describing respectively its new double-duty fuse and "disconnect" cut-out inclosed in plastic wet-process porcelain, not cast and not pressed, its convertible 7,500-volt and 15,000-volt switching equipment, its handy fuse pullers, its C.G. hot-tap clamp, its economy cable clamps and its "no serve" yokes, splice balls and clevises.

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered, further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number:

Purchase and agency are desired in Durango, Mexico (No. 28,617), for electrical appliances and supplies.

Purchase or agency is desired in Cardiff, Wales (No. 28,534), for electric heaters and farm-lighting plants.

Purchase and agency are desired in Auckland, New Zealand (No. 28,543), for household electric ranges and washing machines.

An agency is desired in London, England (No. 28,588), for small household electric appliances.

Purchase and agency are desired in Oporto, Portugal (No. 28,542), for incandescent automobile lamps.

Purchase is desired in Athens, Greece (No. 28,497), of incandescent automobile lamps.

Purchase and agency are desired in Cuayaquil, Ecuador (No. 28,516), for farm gas or hydro-electric lighting sets.

Purchase and agency are desired in Quebec, Canada (No. 28,620), for electric refrigerating units.

An agency is desired in Tallin, Estonia (No. 28,539), for wireless telegraph transmitting and receiving apparatus.

Business Facts for Electrical Men

Selected Statistics Presented Graphically for the Use of All Interested in Analyzing the Trend of the Electrical Business

The Home Gets One-eighth of the Electrical Energy

WHEN the Edison system was introduced, 45 years ago, the supply of energy was used for lighting exclusively. This specific function of the central station was picturesquely embodied in a phrase not unknown during the eighties: When the school-boy peered in through the windows at the big flywheel, or had the rare good fortune to be admitted and have his pocket knife magnetized by a good-natured station attendant, the incident took place, very likely, in the boy's vernacular, at "the electric light factory."

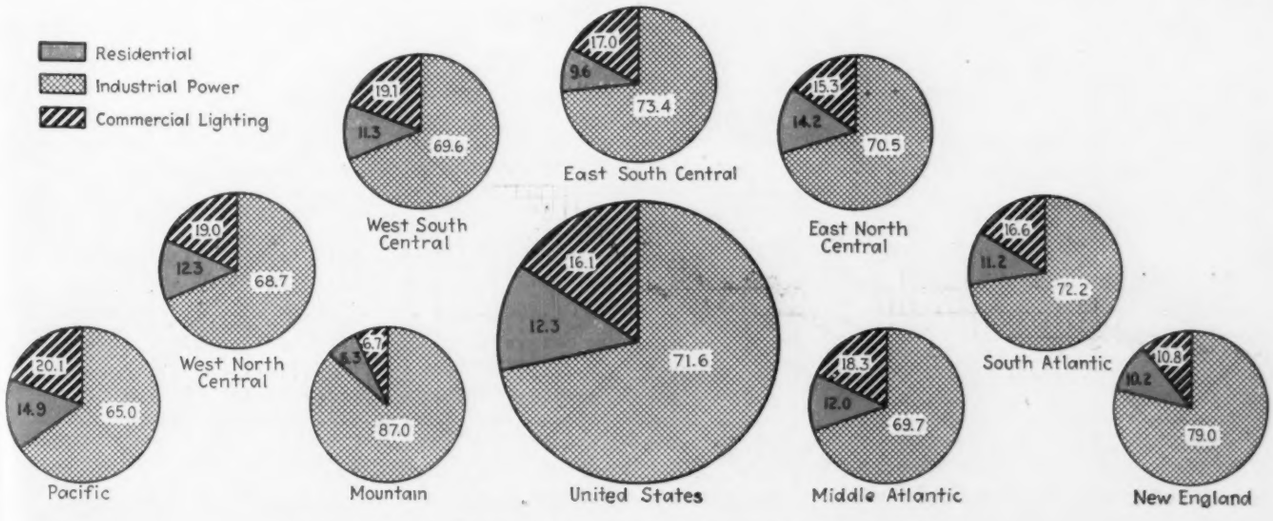
Half as long ago central-station companies were still deeply concerned with problems of filling in the valleys of the load curves. Long strides have been taken toward the solution of that problem so far as the day load is concerned, and more recent efforts to build up a night load have not gone unrewarded.

It is a far cry from the condition of an exclusive lighting load to the present state of affairs, when industrial power consumes considerably more than twice the energy used for lighting in the country as a whole. The chart summarizes data published in detail in the ELECTRICAL WORLD, April 30, 1927. The statistics there presented covered operations during 1926 of all systems in the United States having an annual output of 100,000,000 kw.-hr. or more. The systems listed accounted for 84 per cent of the electrical energy generated by public electric light and power establishments throughout the country. From the published reports the energy consumed for domestic use, commercial lighting and industrial power has been segregated and summarized. Unfortunately, some of the reporting companies were unable to make the threefold segregation requested, but complete returns were obtained in a sufficient number of cases to make possible a fairly close analysis, and the results may be considered representative for the industry as a whole. If some of the companies themselves cannot segregate their operations, who can?

Excluding energy used for railroad operations and energy supplied by one utility to another for subsequent resale, about one-eighth of the sales directly to the public are for domestic purposes, one-sixth for commercial lighting and small power and the rest for industrial power. The ratios differ in different parts of the country, but only in the Mountain States do they depart materially from the national average. Apparently, the demands of the mining industry in that section — and, possibly, irrigation companies—are sufficiently great in proportion to the population to bring the power load up to 87 per cent of the total.

Proportionately the largest lighting load is in the Pacific States; without exception commercial lighting and small power somewhat exceed the residential consumption. The national residential consumption, the one-eighth mentioned above, is distributed among sixteen million consumers, who constitute about 80 per cent of the total number, and whose average use is not far from 400 kw.-hr. per annum. The electrification of industry must continue, but elctrification of the home above the modest amount just quoted offers a large potential field for load building.

Most of the data for statistics in the ELECTRICAL WORLD are gathered by it from original sources. Privilege is freely given to readers of the ELECTRICAL WORLD to quote or use these statistics for any legitimate purpose. While there is no requirement that the source of data be given, yet it would help the ELECTRICAL WORLD in obtaining and compiling further basic information if those who make use of these statistics would give credit to the ELECTRICAL WORLD.



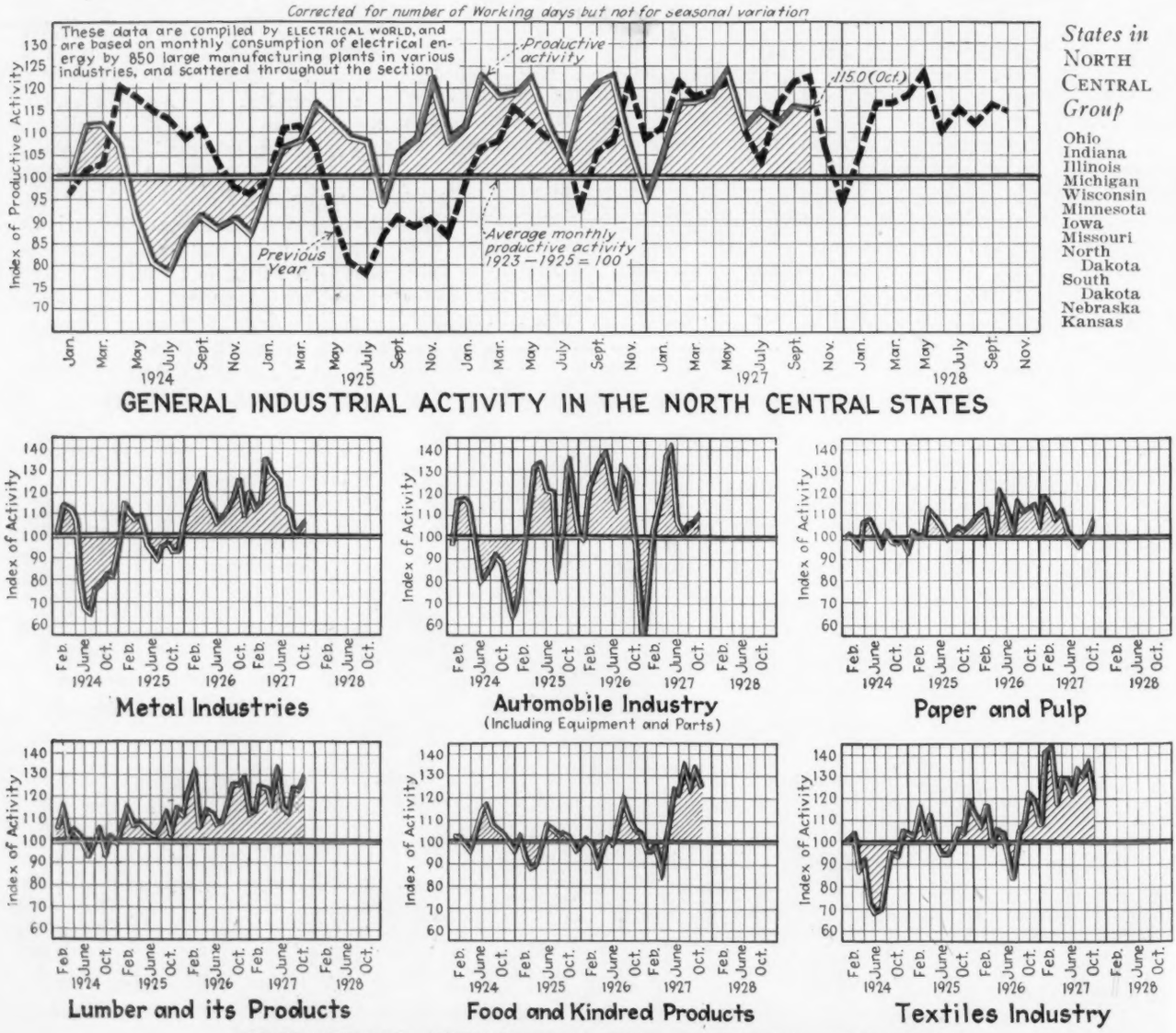
Allocation of Energy Between Lighting and Industrial Power

Industrial Activity in the North Central States 6.7 Per Cent Under 1926

MANUFACTURING plants in the North Central States have since last July been reporting productive activity each month as under that for the same month of 1926. The rate of production in October was 6.7 per cent under October last year, this being the greatest twelve-month decrease in operations reported this year. It appears that, as compared with last year, industrial conditions in the North Central States were less stable than for industry as a whole. Preliminary reports indicate, however, that November witnessed materially improved industrial conditions in this section.

Indexes of Productive Activity in the North Central States
All Figures Adjusted for Number of Working Days

	Oct. 1927	Sept. 1927	Oct. 1926	Average for First Ten Months 1927	Average for Full Year 1926
All industries	115.0	116.4	123.4	115.4	114.4
Chemical and allied products	112.8	109.7	119.8	99.4	112.8
Textiles	119.0	137.0	121.2	130.7	106.4
Lumber and its products	130.0	123.4	125.8	121.4	117.6
Paper and pulp	108.8	101.3	111.5	105.9	110.0
Automobiles, including parts and equipment	111.6	107.3	108.5	111.4	113.7
Metals group	107.4	100.0	126.0	115.1	116.2
Rolling mills and steel plants	108.5	102.6	126.0	119.4	118.6
Ferrous and non-ferrous metal working plants	101.8	93.2	.....	.....	.....
Food and kindred products	133.4	124.8	.....	.....	.....
Leather and its products	118.3	117.0	.....	.....	.....

During October five of the section's primary industrial groups—the automobile industry (including parts and equipment), lumber and its products, food and kindred products, leather and its products, and rubber products—witnessed productive activities materially over those reported for October, 1926. On the other hand, six just as important industrial groups—chemical and allied products, textiles, paper and pulp, rolling mills and steel plants, ferrous and non-ferrous metal working plants, and the stone, clay and glass industry—reported activities under those of last year. It is this ability of general American industry to balance its operation which is one of the basic factors underlying our continued general prosperity.

ELECTRICAL WORLD *Barometer of Industrial Activity in the North Central States*